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ABSTRACT

The interest-based curriculum materials are designed to correlate the subjects of English, math, science, and home economics and infuse academic skills into the world of work. The House Care Science curriculum guide is divided into five units: (1) measurement, (2) household chemistry, (3) household electricity, (4) household machines, and (5) heat, light, and sound. Each unit is organized around objectives, experiments, evaluative material (unit exams), instructional materials, and references. The unit on measurement applies the metric system to density and specific gravity problems. The household chemistry unit activities deal with the three states of matter: solids, liquids, and gases. Principles of electricity are stressed in both the household electricity and household machines units, while the final unit on heat, light, and sound applies principles and theories relating to the use of energy in the home. (JB)

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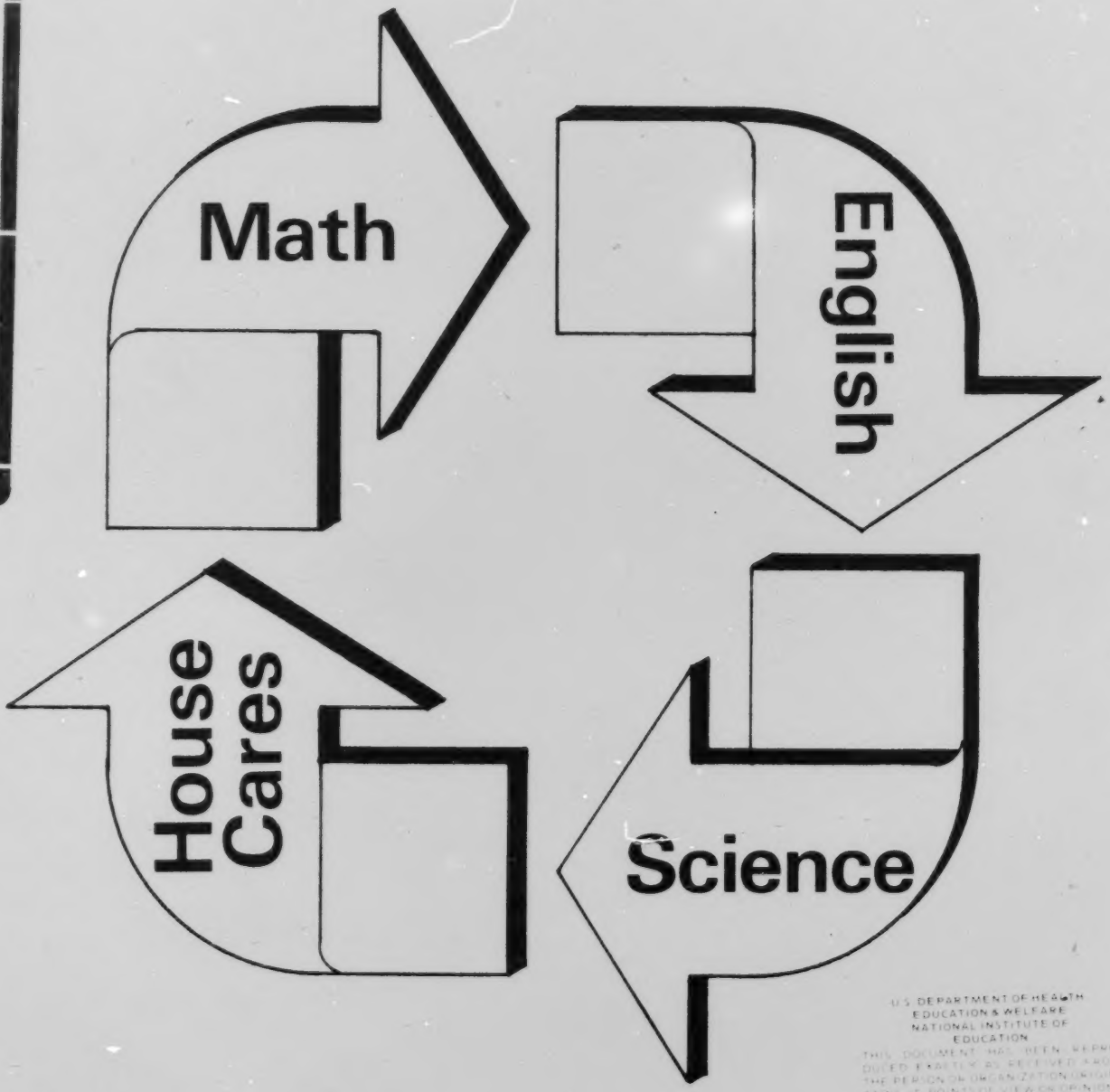
NTEREST-BASED CURRICULUM
FOR
HOUSE CARE SERVICES

ED107809



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CE003708

SCIENCE

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INTRODUCTION

The interest-based curriculum materials are designed to correlate the subjects of English, math, science, and home economics in an effort to make education more interesting and relevant to the Natchitoches Parish students. Objectives of the curriculum guides are divided into four categories. They are: (1) Program Objectives; (2) Performance Objectives; (3) Process Objectives; and (4) Activities. The three numbers in sequence separated by a dash represent the performance objective, process objective, and activity respectively. This method of identification allows for easy monitoring of the objectives on the monitorial sheet after each unit. An abundance of instructional materials can be used in conjunction with the interest-based curriculum. It is only designed to be a guide for infusing the academic skills into the everyday world of work. The interest-based curriculum guides were developed under the direction of John Vandersypen, Site Coordinator of an Exemplary Program for Career Education, during the 1973-74 school year.

The following classroom teachers participated in the development of these materials:

Sylvia Brown - English
Evelyn Gair - Home Economics
Patsy Johnson - Home Economics
Eliza Jones - Math
Annie Reed - Home Economics
Fred Sullivan - Science

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An Exemplary Program For Career Education

Exemplary Project in Vocational Education
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Part D of Public Law 90-576

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April 1974

UNIT I

HOUSE CARE SCIENCE

MEASURING THINGS

UNIT I
Measuring Things

1-0-0 Upon completion of this unit the house care student will demonstrate a knowledge of and proficiency in measurement as evidenced by at least a 70% score on a teacher-made test.

1-1-0 In five to seven class periods the project teacher will provide activities enabling the house care student to measure objects using the metric system as documented on the project monitorial system.

1-1-1 Activity: The Metric System

1-1-2 Measure some objects commonly found in the home using a metric ruler.

1-1-3 Find the dimensions of the room using a meter stick.

1-1-4 Determine the volume, in liters, of several boxes, cabinet drawers, the classroom, or other suitable objects having volume.

1-1-5 After a demonstration on the use of laboratory balances, the student will weigh several household objects to the nearest tenth of a gram.

1-1-6 Using a graduated cylinder, measure the volume of a quart Mason jar by filling it with water.

1-1-7 Using a dropping pipette and a 10 cc graduated cylinder, determine the number of drops in a cubic centimeter by counting the number of drops required to fill the graduate to the 10 cc mark and dividing by 10 to get the average.

1-2-0 In two or three class periods the project teacher will provide experiences and activities in temperature measurement as documented on the project monitorial system.

1-2-1 Provide thermometer having Centigrade divisions and Fahrenheit divisions and explain to the students how to read temperatures.

1-2-2 Provide clinical thermometers ("fever thermometers") and demonstrate the proper methods of using this type of thermometer.

1-2-3 Activity: Temperature Measurement

1-2-4 Make a simple thermometer by inserting a 50 cm length of glass tubing into a one-hole rubber stopper, which is then fitted into a 500 cc Florence flask half filled with water. The tubing should extend nearly to the bottom of the flask. Show how heating causes the expansion of the liquid in the flask; cooling causes contraction.

1-2-5 Activity: Supplemental Temperature Problems

1-3-0 In two or three clas periods the project teacher will provide activities that demonstrate means of measuring heat in calories in foods as documented on the project monitorial system.

1-3-1 Activity: Measuring Calories in Foods

1-3-2 Find the number of calories per minute used for the following activities: swimming, running, bowling, ironing, doing light housework, playing with children, standing at ease, and sitting.

1-4-0 In three to five class periods the project teacher will provide activities that illustrate density and specific gravity as documented on the project monitorial system.

1-4-1 Activity: Densities of Liquids

1-4-2 Activity: Density Problems

1-4-3 Activity: Density and Specific Gravity Problems

1-5-0 Unit Test

1-1-1 Activity: The Metric System

A. The Metric Tables

The metric system is built upon the decimal system; that is, that ten of one unit is equal to the next larger unit, with one exception. Our money system is an example of the same system. (It takes 10 pennies to make one dime, and 10 dimes to make $1.00. It takes ten $1.00 bills to make $10.00 and ten $10.00 bills to make $100.00, etc.) The following tables give the relationship between the most commonly used units of the metric system.

PREFIXES:
- kilo - means 1000 times the unit
- deci - means 1/10 of the unit
- centi - means 1/100 of the unit
- milli - means 1/1000 of the unit

LENGTH

The metric standard of length is 100 centimeters or one meter (m). It is divided into a thousand equal parts called millimeters (mm) The millimeter in turn is divided into a thousand equal parts called microns (M). Micro means one millionth and a micron is one millionth of a meter. This unit is most convenient in microscopic measurements, just as the centimeter is most convenient for ordinary sizes. Similarly, the angstrom (A) is most convenient in atomic measurements, and the micron equals 10,000 angstroms.

ABBREVIATIONS FOR LENGTH:

km - kilometer	mm - millimeter
m - meter	M - micron
dm - decimeter	mM - millimicron
cm - centimeter	A - angstrom

From the largest unit to the smallest unit:

1 kilometer = 1,000 meters
1 meter = 10 decimeters = 100 centimeters = 1000 millimeters

or:

1 km = 1,000 m	1 M = 10^{-4} cm
1 m = 10 dm	1 mM = 10^{-7} cm
1 dm = 10 cm	1 A = 10^{-8} cm
1 cm = 10 mm	

All British and U.S. units of length are easily converted to metric units by remembering just one interrelation:

1 inch = 2.54 cm

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CONVERSION FACTORS FOR LENGTH

1 inch (in.)	2.540 cm	1 centimeter	0.3937 in.
1 foot (ft.)	30.48 cm	1 meter	3.281 ft.
1 mile (mi.)	1.609 km	1 meter	39.37 in.
		1 kilometer	0.6214 mi.

WEIGHT

The same prefixes are used in the metric system of weight. The only thing that is changed is the unit. Instead of meter, it is gram.

ABBREVIATIONS FOR WEIGHT:

kg -	kilograms	cg -	centigrams
g -	grams	mg -	milligrams
dg -	decigrams		

From the largest unit to the smallest:

1 kg = 1,000 g
1 g = 10 dg = 100 cg = 1,000 mg

or:

1 kg = 1,000 g
1 g = 10 dg; also, 1 g = 1,000 mg
1 dg = 10 cg
1 cg = 10 mg

The British unit of mass (weight) is the commercial or avoirdupois pound, otherwise defined as 7000 grains. There are 16 ounces in one pound (avoir).

CONVERSION FACTORS FOR MASS (OR WEIGHT)

1 pound (avoir) = 453.6 g or 454 g	1 kilogram = 2.205 lb. (avoir)
1 ounce (avoir) = 28.35 g	1 gram = 15.43 grains

The U.S. short ton is 2000 lbs., the British long ton is 2240 lbs., and the metric ton (1000 kg) is 2205 lbs.

AREA

Throughout your problem sheets the system of using cm^2 to represent square centimeters will be used. Thus, the exponent 2 will always indicate square units and the exponent 3 will indicate cubic units. (At this point you might start the practice of writing large numbers like 6,000,000 as a power of 10, thus: $6 \times 10^6 = 6{,}000{,}000$.)

In order to change any unit of length to the corresponding unit of area it is only necessary to square the units, thus:

$1\ km^2 = (1000)^2 m^2$ or $1\ m^2 = (10)^2\ dm^2$ or $1\ cm^2 = (10)^2\ mm^2$

ABBREVIATIONS FOR AREA:

km^2 means square kilometers

m^2 means square meters

dm^2 means square decimeters

cm^2 means square centimeters

mm^2 means square millimeters

From the largest unit to the smallest:

$1\ km^2 = (1{,}000)^2 m^2$ or $1{,}000{,}000\ m^2$

$1\ m^2 = (10)^2\ dm^2 = (100)^2\ cm^2 = (1{,}000)^2\ mm^2$

NOTE: $(10)^2$ means (10 x 10); $(100)^2$ means (100 x 100); etc.

or:

$1\ km^2 = (1{,}000)^2\ m^2$

$1\ m^2 = (10)^2\ dm^2$

$1\ dm^2 = (10)^2\ cm^2$

$1\ cm^2 = (10)^2\ mm^2$

Use the conversion factors given for length at the top of the preceding sheet.

VOLUME

In order to change any unit of length to the corresponding unit of volume it is only necessary to cube the units, thus:

$1\ km^3 = (1{,}000)^3\ m^3$; $1\ cm^3 = (10)^3\ mm^3$

ABBREVIATIONS FOR VOLUME:

cm^3 or cc means cubic centimeter

mm^3 means cubic millimeter

l means liter

ml means milliliter

However, there is this difference in the calculation of volume. The unit of volume commonly used is the "liter" which is equal to 1 dm^3. On this basis we have these units:

1 liter = 10 deciliters (dl)
1 liter = 100 centiliters (cl)
1 liter = 1000 milliliters (ml) (about 1 cm^3)

From the largest unit to the smallest unit:

1 l = 1,000 ml = 1,000 cm^3

(1 ml = 1 cm^3 = 1 cc)

1 cm^3 = $(10)^3$ mm^3 or 1,000 mm^3

1 ml equals 1 cc and are used interchangeably

Do you notice the similarity between the tables above?

B. Changing From One Unit to Another

In changing from one unit to another, find the unit ratio which when used as a multiplier will cancel out other units and give the unit desired for the answer.

EXAMPLE: How many mm are in 6 km?

(a) $6 \text{ km} \times \frac{1{,}000 \text{ m}}{1 \text{ km}} \times \frac{1{,}000 \text{ mm}}{1 \text{ m}}$ 6,000,000 mm or 6×10^6 mm

(b) $6 \text{ km} \times \frac{1{,}000 \text{ m}}{1 \text{ km}} \times \frac{10 \text{ dm}}{1 \text{ m}} \times \frac{10 \text{ cm}}{1 \text{ dm}} \times \frac{10 \text{ mm}}{1 \text{ cm}}$ 6,000,000 mm or 6×10^6 mm

C. Addition of Metric Units

In order to add metric units, all units must be converted to the same unit. (Just as in the addition of fractions.) This should be clear from the following example:

EXAMPLE: Add 25 m, 12 dm, 125 cm and 82 mm and express the results in cm.

SOLUTION:

25 m = 2500 cm
12 dm = 120 cm
125 cm = 125 cm
82 mm = 8.2 cm

The answer is: 2753.2 cm

PROBLEMS

1. Write 5 m, 2 cm, 7 mm, and 1 dm as meters, and add.
2. Write Problem 1 as centimeters, and add.
3. Write 2 cm, 3 dm, and 7 mm as meters, and add.
4. Write 8 m, 5 dm, and 4 mm as decimeters, and add.
5. Write 64 m, 4 mm, and 12 dm as centimeters, and add.
6. Write 700 m, 15 dm, 22 cm, and 31 mm as millimeters, and add.
7. Write the numbers in Problem 6 as kilometers, and add.
8. Write 52 m, 12 dm, 3 cm as kilometers, and add.
9. Write 5 m, 4 mm as millimeters, and add. Change this answer to: (a) cm (b) m (c) km , by moving the decimal point to its proper position in each instance.
10. Write 8 cm as meters, millimeters, and kilometers.
11. Write 5 cm as meters, millimeters, and decimeters.
12. Write 0.5 cm as millimeters, meters, and kilometers.
13. Write 4.8 m as centimeters, millimeters, and kilometers.
14. Write 36 cm as meters, kilometers, and millimeters.
15. Write 56 mm, 36 cm, and 55 m as meters, and add.
16. Write 25 cm, 16 mm, and 15 m as kilometers, and add.
17. Write 12.5 m, 142 cm, and 2.15 mm as millimeters, and add.
18. Write 13.7 m, 4.17 cm, and 21.54 mm as centimeters, and add.
19. Write 0.5 m, 1.8 cm, and 92 mm as decimeters, and add.
20. Write 2.5 cm, 12.5 dm and 2.67 m as millimeters, and add.
21. Write 8 gm, 9 dgm, and 7 cgm as grams.
22. Write 9 dgm, 6 gm, and 7 kgm as grams.
23. Write the quantities given in Problem 22 as kgms.
24. How many kg are there in 14,598 gms?
25. How many kg are there in 95,874 gms?
26. How many cgm are there in 495,863 dgms?
27. Add 18 kg, 357 g, and 35 cg as gms.
28. Write 895 g, 57.4 cg, 927 dg, and 85 kg as gms and add.
29. How many grams are there in 58 dg? 0.05 dg? and 0.067 g?
30. How many kilograms are there in 58 dg? 0.05 dg, and 1.067 g?

---

31. Change 12,456 square centimeters to square meters.
32. How many square centimeters are there in 57 square meters?
33. Write 436 sq. dm as sq. cm.
34. Write 928 sq. m, 384 sq. dm, and 746 sq. m as m^2, and add.
35. How many sq. cm are there in 4,597 sq. dm and 254 m^2?

---

36. How many liters are there in 1278 cubic centimeters?
37. How many milliliters are there in 546 liters?
38. Change 12,397 cubic meters to liters.
39. Write 25 ml, 59 deciliters, 125 cm^3 as liters, and add.
40. How many liters are there in a room that measures 7 m, 5 dm long, by 8m, 9cm wide, by 5 m high?

1-2-3 Activity: Temperature Measurement

TEMPERATURE may be defined as that property of a body which determines the flow of heat. Two bodies are at the same temperature if there is no transfer of heat when they are placed together. Temperature is a fundamental concept, an intrinsic dimension which cannot be defined in terms of mass, length, and time dimensions.

CENTIGRADE AND FAHRENHEIT SCALES. Although the international standard measure of temperature is a gas thermometer, a liquid thermometer of the type commonly used in laboratories may be used to illustrate the thermometric scales. Two fixed points are chosen for standardizing a thermometer, usually the freezing point and boiling point of water under one atmosphere pressure. The thermometer liquid (mercury, for example) is allowed to come to the termperature of a fixed point, and the height of the liquid in the thermometer which corresponds to the fixed point temperature is noted.

On the centigrade scale ($^{\circ}$C) the freezing point of water is 0° and the boiling point is 100° at one atmosphere pressure. The distance between the two fixed point levels on the thermometer is divided in 100 equal parts, and each division corresponds to 1°C. Equally spaced divisions may be extended above and below the fixed points.

On the fahrenheit scale ($^{\circ}$F) the freezing point of water is 32° and the boiling point is 212°. The distance between the two fixed point levels on the thermometer is divided into 180 equal parts, and each division corresponds to 1°F. Equally spaced divisions may be extended above and below the fixed points.

CONVERSION OF CENTIGRADE AND FAHRENHEIT. Between the freezing and boiling points of water there are 100 centigrade or 180 fahrenheit intervals. Then 100 centigrade intervals = 180 fahrenheit intervals. Hence:

$$1 \text{ centigrade interval} = \frac{180}{100} = \frac{9}{5} \text{ fahrenheit intervals}$$

$$1 \text{ fahrenheit interval} = \frac{100}{180} = \frac{5}{9} \text{ centigrade interval}$$

But the freezing point of water is 0° on the centigrade scale and 32° on the fahrenheit scale, or 0° C = 32° F. Then:

$$\text{Temperature centigrade} = 5/9 \times \text{temperature fahrenheit} - 32$$

$$\text{Temperature fahrenheit} = 9/5 \times \text{temperature centigrade} + 32$$

ABSOLUTE KELVIN SCALE. All gases held at constant volume show a uniform increase in pressure with increasing temperature. Experiments show that the pressure of a gas increases 1/273 of its pressure at 0°C for each degree the temperature is raised above 0°C.

Similarly, when the temperature of the gas is lowered, the pressure decreases 1/273 of its pressure at $0^{\circ}C$ for each degree the temperature is lowered. It follows that a gas will no longer exert a pressure when the temperature becomes 273° below $0^{\circ}C$. This temperature ($-273^{\circ}C$) at which the gas molecules cease to exert a pressure (cease to move, according to the kinetic theory) is called the absolute zero of temperature. (Although the exact value for the absolute zero is a fraction of a degree less than $-273^{\circ}C$, $-273^{\circ}C$ will be sufficiently accurate for the problems that follow.)

The absolute zero of temperature, $-273^{\circ}C$, is taken as the zero point on the absolute kelvin scale ($^{\circ}K$). The kelvin and centigrade scales differ only in the choice of the zero point. Kelvin temperature = 273 + centigrade temperature.

SOLVED PROBLEMS

1. Ethyl alcohol boils at $78.5^{\circ}C$ and freezes at $-117^{\circ}C$, at one atmosphere pressure. Convert these temperatures to the fahrenheit scale.

Fahrenheit = 9/5 x centigrade + 32

$78.5^{\circ}C = 9/5 \times 78.5 + 32 = 141 + 32 = 173^{\circ}F$

$-117^{\circ}C = 9/5 \times (-117) + 32 = -211 + 32 = -179^{\circ}F$

2. Mercury boils at 675 F and solidifies at -38.0 F, at one atmosphere pressure. Express these temperatures in centigrade units.

Centigrade = 5/9 x (fahrenheit - 32)

$675^{\circ}F = 5/9 \times (675 - 32) = 5/9 \times 643 = 357^{\circ}C$

$-38.0^{\circ}F = 5/9 \times (-38.0 - 32) = 5/9 \times (-70.0) = -38.9^{\circ}C$

3. Change $40^{\circ}C$ and $-5^{\circ}C$ to the kelvin scale.

Kelvin temperature = centigrade temperature + 273

$40^{\circ}C = 40 + 273 = 313^{\circ}K$

$-5^{\circ}C = -5 + 273 = 268^{\circ}K$

4. Convert $220^{\circ}K$ and $498^{\circ}K$ to the centigrade scale.

Centigrade temperature = kelvin temperature - 273

$220^{\circ}K = 220 - 273 = -53^{\circ}C$

$498^{\circ}K = 498 - 273 = 225^{\circ}C$

5. Express $-22^{\circ}F$ in degrees centigrade and in degrees kelvin.

Centigrade = 5/9 x (F - 32) = 5/9 x (-22 - 32) = 5/9 x (-54)

= $-30^{\circ}C$

Kelvin = 273 + centigrade = 273 - 30 = $243^{\circ}K$

SUPPLEMENTARY PROBLEMS FOR YOU TO WORK

1. (a) Reduce $68^{\circ}F$ to C; $5^{\circ}F$ to C; $176^{\circ}F$ to C.

Answers: $20^{\circ}C$; $-15^{\circ}C$; $80^{\circ}C$

(b) Reduce $30^{\circ}C$ to F; $5^{\circ}C$ to F; $-20^{\circ}C$ to F.

Answers: $86^{\circ}F$; $41^{\circ}F$; $-4^{\circ}F$.

2. Convert the following temperatures: $-195.5^{\circ}C$ to F; $-430^{\circ}F$ to C; $1705^{\circ}C$ to F.

Answers: $-319.9^{\circ}F$; $-256.7^{\circ}C$; $3101^{\circ}F$

3. The temperature of dry ice (sublimation temperature at normal pressure) is $-109^{\circ}F$. Is this hotter or colder that the temperature of boiling ethane (a component of bottled gas) which is $-88^{\circ}C$?

Answer: Hotter

4. Convert $300^{\circ}K$, $760^{\circ}K$, $180^{\circ}K$, to degrees centigrade.

Answers: $27^{\circ}C$; $487^{\circ}C$; $-93^{\circ}C$

5. Express $0^{\circ}K$, $273^{\circ}K$, in degrees fahrenheit.

Answers: $-459^{\circ}F$; $32^{\circ}F$

6. Convert $14^{\circ}F$ to degrees centigrade and degrees kelvin.

Answers: $-10^{\circ}C$; $263^{\circ}K$

7. Express $0^{\circ}F$ and $100^{\circ}F$ in degrees centigrade.

Answers: $-17.8^{\circ}C$; $37.8^{\circ}C$

8. Who was Gabriel Fahrenheit? See source books in library for the history of his life and work.

1-2-5 Activity: Supplementary Temperature Problems

1. Change 10 degrees C to F.
2. Change 30 degrees C to F.
3. Change 40, 50, 60, and 100 degrees C to F.
4. Change 212 degrees C to F.
5. Change 180 degrees C to F.
6. Change -30, -50, -70, and -90 degrees C to F.
7. Change 10 degrees F to C.
8. Change 20 degrees F to C.
9. Change 40, 60, 100, -130, -60, and 150, 200, 400, and -560 degrees F to C.
10. Change 10, 20, -3, 60, 100, -300, -50, and 150 degrees C to A.
11. What temperature F is 30 degrees F?
12. What temperature C is 40 degrees F?
13. What degree F is 500 degrees Absolute?
14. What degree F is 300 degrees Absolute?

The following problems are for the smart ones to strain their neurons on for EXTRA CREDIT.

15. At what temperature is the F reading twice of that of the C reading?
16. At what temperature do the C and F scales read the same?
17. At what temperature does the F scale read three times that of the C scale?
18. At what temperature does the F scale read 20 more than the C scale.
19. At what temperature does the F scale read four-fifths that of the C scale?
20. At what temperature does the F scale read 75 more than the C scale?

1-3-1 Activity: Measuring Calories in Foods

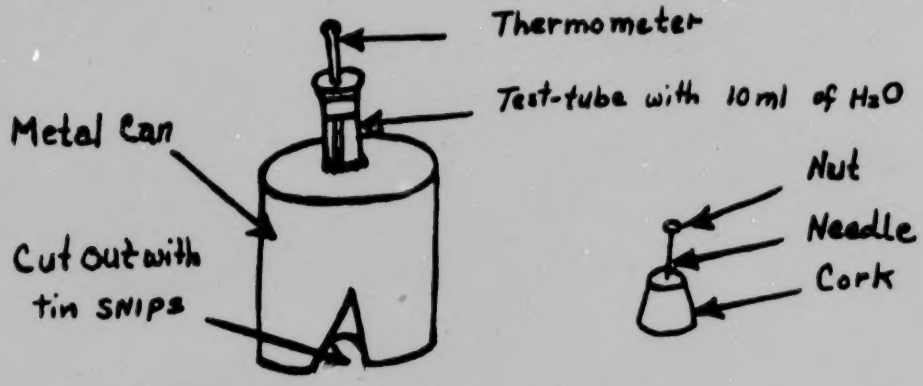
EXPLANATION: The unit for measuring the chemical energy in food is the calorie. This chemical energy can be released by burning. A calorie is the amount of heat needed to raise the temperature of one milliliter of water one degree on the Centigrade scale.

Data on the temperature increase, amount of water, and amount of material burned are necessary. Dehydrated foods and nuts are good foods to use. A data sheet similar to the one below may be used to collect data.

Material	Temp at end of experiment	Temp at beginning - of experiment =	Temp Difference	No. of x ml = Calories

OBJECTIVE: Determine the number of calories in some foods.

PROCEDURE: Design and build a calorimeter. The diagram below is an example of a type of apparatus that the students might design.



Weigh and burn several kinds and quantities of foods. Do not leave the thermometer in the test tube while burning the food.

INTERPRETATION: Help the students organize the data and do the calculations. Compare the results of the different foods.

1-4-1 Activity: Densities of Liquids

EXPLANATION: Each form of matter has a certain mass or weight. The density of a liquid can be determined by comparing its mass (M) with its volume (V). Thus, Density = $\frac{\text{Mass}}{\text{Volume}}$ or D = M/V.

OBJECTIVE: Determine the density of various household liquids.

PROCEDURE: Weigh a 150 ml beaker on the laboratory balances. Record its weight in the table below. Measure 100 ml of each of the liquids listed in the table. Find the weight of the liquid by weighing both liquid and beaker and subtracting the weight of the beaker. Determine the density of each liquid.

Weight of beaker _____

Liquid Tested	Volume in ml	Weight in gms	Density per ml
Water			
Cooking Oil			
Rubbing Alcohol			
Glycerin			
Whole Milk			

INTERPRETATION: A: Answer the following True-False statements:

_____ 1. If cooking oil and water were mixed, the cooking oil would float on top of the water.

_____ 2. Whole milk has a greater density than skim milk.

_____ 3. If a liquid has a density greater than 1, it will float on water.

_____ 4. The same volume must be weighed each time in order to find its density.

B: Explain why milk is homogenized to prevent the cream from separating and floating on top of the milk.

1-4-2 Activity: Density Problems

Density is defined as the amount of mass (weight) per unit of volume or:

$$\text{Density} = \frac{\text{Mass}}{\text{Volume}} = \frac{\text{Weight}}{\text{Volume}}$$

Density will always be expressed in a unit such as gms/cm^3, gms/ml, lbs/ft^3, etc. Thus, the density of water in the metric system is 1 gm/ml, while in the English system, it is 62.4 lbs/ft^3.

Specific Gravity is defined as the number of times heavier a substance is than an equal volume of water or:

$$\text{Specific Gravity} = \frac{\text{Weight of a Substance}}{\text{Weight of an equal volume of water}}$$

Since both the numerator and denominator in the above expression are expressed in the same units (gms/ml, or lbs/ft^3), then specific gravity will have no unit or dimension, but will be an abstract number such as 1.4 meaning that the substance is 1.4 times heavier than water.

Numerically, density and specific gravity are the same (in the metric system), but the meanings are entirely different.

EXAMPLE: Find the density of a substance that weighs 125 gms per 100 ml.

SOLUTION: $\text{Density} = \frac{\text{weight}}{\text{volume}} = \frac{125 \text{ gm}}{100 \text{ ml}} = 1.25 \text{ gm/ml}$

EXAMPLE: How much will 3 ml of nitric acid weigh if the acid has a density of 1.22 gm/ml?

SOLUTION: $\text{Density} = \frac{\text{weight}}{\text{volume}} = 1.22 \text{ gms} = \frac{\text{weight}}{3 \text{ ml}} = 3.66 \text{ gms}$

EXAMPLE: What will be the weight of 350 ml of nitric acid that has a specific gravity of 1.22?

SOLUTION: $\text{Specific gravity} = \frac{\text{weight of substance}}{\text{weight of equal vol. of HOH}}$

$1.22 = \frac{\text{weight}}{350 \text{ ml}}$ (NOTE: While 350 ml is given in the problem as the volume of nitric acid, it is also the volume of water.)

PROBLEMS

1. An aluminum ball weighs 66.4 gms. The volume of the ball is 24 ml. Find the density of the aluminum.

2. One cubic foot of copper weighs 518.1 lbs.
   A. Find the density of the copper in lbs/ft^3.
   B. Find the density of the copper in gms/ml.

3. Find the weight of a bar of lead 15 cm long, 3 cm wide, and 2 cm thick. The density of lead is 11.3 gm/ml.

4. Find the weight of 100 ml of sulfuric acid that has a density of 1.81 gm/ml.

5. Cobalt has a density of 8.71 gm/ml. What would be the volume of 100 gms of cobalt?

6. Concentrated sulfuric acid has a specific gravity of 1.87. What would be the volume of 100 ml of this acid?

7. The weight of 1 cubic foot of some of our heaviest metals are given below. Calculate their densities in gm/ml.

   A. Uranium - 1157.6 lbs.
   B. Osmium - 1404.6 lbs.
   C. Tantalium - 1036.6 lbs.

1-4-3 Activity: Density and Specific Gravity Problems

Density is defined as the mass or quantity of matter (weight) of a substance contained in one unit of its volume. A dense substance is one which has a large quantity of matter in a small volume.

$$\text{Density} = \text{mass per unit volume} = \frac{\text{mass of body}}{\text{volume of body}}$$

or: $$\text{Density} = \frac{\text{Mass}}{\text{Volume}} = \frac{\text{Weight}}{\text{Volume}}$$

There are many possible units for density such as lbs/ft^3, g/ml, kg/l, etc. The density of solids and liquids is usually expressed in grams per cubic centimeter (g/cm^3 or g/cc), in grams per milliliter (g/ml), or in pounds per cubic foot (lb/ft^3). The density of gases is expressed in grams per liter (g/l).

The density of water in the metric system is 1.0 g/ml, while in the English system it is 62.4 lbs/ft^3. It may be expressed thus:

Density of water at $4^{\circ}C$ = 1 g/cm^3 = 1 g/ml (Metric System)

Density of water at $4^{\circ}C$ = 62.4 lb/ft^3 (English System)

One should never use the term density without giving its units because of the possibility of confusion with the various systems of measurement.

Specific gravity is defined as the number of times heavier a substance is than an equal volume of water; or, we may think of specific gravity as a measure of the weight of an object compared to the weight of an equal volume of water (water being taken as a standard). Solids and liquids are referred to water as standard, while gases are often referred to air as standard.

$$\text{Specific Gravity} = \frac{\text{Weight of solid or liquid}}{\text{Weight of an equal volume of water}}$$

or: $$\text{Specific Gravity} = \frac{\text{Density of object}}{\text{Density of water}}$$

Since both the numerator and the denominator in the above expressions are expressed in grams, or in pounds, etc., specific gravity will have no units, or dimension, but will be a pure or abstract number such as 1.4, meaning that the substance (solid or liquid) is 1.4 times as heavy as an equal volume of water.

Thus, if a piece of aluminum weighs 2.70 times as much as an equal volume of water, its specific gravity is 2.70 in any system of measures.

Since the density of water in the metric system is 1 g/cc (or 1 g/ml), the density of aluminum in that system is 2.70 g/cc (or 2.70 g/ml). The density and specific gravity of a substance are numerically the same when the density is expressed in grams per cc (or in grams per ml), but their meanings are entirely different.

In the British system, the specific gravity of aluminum is also 2.70. But the density of aluminum in British units = 2.70 x density of water =

$$2.70 \times 62.4 \text{ lb/ft}^3 = 168 \text{ lb/ft}^3$$

REMEMBER that the specific gravity of a substance is the same in any system of units, since it expresses the quotient of the weight (mass) of a substance divided by the weight (mass) of an equal volume of water.

EXAMPLE: Find the density of a substance that weighs 125 grams per 100 ml.

$$\text{Density} = \frac{\text{Mass}}{\text{Volume}} = \frac{125 \text{ gm}}{100 \text{ ml}} = 1.25 \text{ g/ml}$$

EXAMPLE: Calculate the density and specific gravity of a body that weighs 420 g and has a volume of 52 cc.

$$D = \frac{M}{V} = \frac{420 \text{ g}}{52 \text{ cc}} = 8.1 \text{ g/cc or } 8.1 \text{ g/ml}$$

$$\text{sp gr} = \frac{\text{Density of object}}{\text{Density of water}} = \frac{8.1 \text{ g/cc}}{1 \text{ g/cc}} = 8.1$$

EXAMPLE: How much will 3 ml of nitric acid weigh that has a density of 1.22 g/ml?

$$\text{Mass (weight)} = \text{Density} \times \text{Volume} = 1.22 \frac{\text{g}}{\text{ml}} \times 3 \text{ ml} = 3.66 \text{ g}$$

EXAMPLE: Determine the volume in gallons of 400 lbs of cottonseed oil, specific gravity 0.926. One gallon of water weighs 8.35 lbs.

Density of oil (British System) = 0.926 x density of water

= 0.926 x 8.34 lb/gal

$$\text{Volume} = \frac{\text{Mass}}{\text{Density}} = \frac{400 \text{ lb}}{0.926 \times 8.34 \text{ lb/gal}} = 51.8 \text{ gallons}$$

EXAMPLE: Calculate the weight in pounds of 3.00 ft^3 of glycerine, sp gr 1.26.

Density of glycerine = 1.26 = Density of water = 1.26 x 62.4 lb/ft^3

Mass (weight) = Density x Volume = 1.26 x 62.4 lb/ft^3 x 3 ft^3

= 236 lbs.

REMEMBER: The density of any substance = sp gr of the substance x the density of water.

EXAMPLE: What will be the weight of 350 ml of nitric acid that has a specific gravity of 1.22?

Density of nitric acid = sp gr of nitric acid x density of water

Density of nitric acid = 1.22 x 1 gm/ml = 1.22 g/ml

Mass (weight) = Density x Volume

Mass (weight) = 1.22 g/~~ml~~ x 350 ~~ml~~ = 427 g

PROBLEMS

1. An aluminum ball weighs 66.4 grams. The volume of the ball is 24 ml. What is the density of aluminum?

2. One cubic foot of copper weighs 518.1 lbs.
   (a) Find the density of copper in lbs/ft^3
   (b) Find the density of copper in g/ml.

3. Find the weight of a bar of lead 15 cm long, 3 cm wide, and 2 cm thick. The density of lead is 11.3 g/ml.

4. Find the weight of 100 ml of sulfuric acid that has a density of 1.81 gm/ml.

5. Find the densities indicated below from the facts given:

	METAL	WEIGHT OF 1 ft^3	Density In lbs/ft^3	Density In g/ml
(a)	Pure Iron	490.1 lbs		
(b)	Steel	474.4 lbs		
(c)	Magnesium	168.7 lbs		
(d)	Sodium	60.6 lbs		
(e)	Nickel	536.9 lbs		
(f)	Silver	650.5 lbs		

6. Write the density and specific gravity of each of the following metals in the space provided.

	METAL	WEIGHT OF 1 ml	DENSITY	SPECIFIC GRAVITY
(a)	Pure Iron	7.85 g		
(b)	Gold	19.3 g		
(c)	Silver	10.43 g		
(d)	Zinc	7.04 g		
(e)	Potassium	0.87 g		

7. From the results obtained in Problem 6 determine the weight of one cubic foot of each of the following metals.
   (a) Pure Iron (b) Gold (c) Silver (d) Zinc (e) Potassium

1-5-0 UNIT TEST: MEASUREMENT

1. The unit of length used in the metric system is the:

   (a) foot (b) liter (c) gram (d) meter

2. The unit of volume in the metric system that is most nearly equal to a quart is the:

   (a) liter (b) kilogram (c) meter (d) pound

3. Which of the following is equal to ten inches?

   (a) 10 cm (b) 2.54 cm (c) 25.4 cm (d) 254 cm

4. Which of the following is equal to ten millimeters?

   (a) 0.1 meter (b) 1.0 cm (c) 0.01 km (d) 1 meter

5. In the metric system the prefix which means one-thousandth is:

   (a) micro (b) mini (c) milli (d) kilo

6. How many meters are there in 1.23 kilometers?

   (a) 123 (b) 12.3 (c) .123 (d) 1,230

7. Ethyl alcohol boils at 78.5 C. Express this in fahrenheit temperature.

   (a) 110.5°F (b) 78.5°F (c) 173°F (d) 17.3°F

8. On the centigrade scale the boiling point of water is:

   (a) 212°C (b) 100°C (c) 0°C (d) 180°C

9. Convert 27°C to kelvin temperature.

   (a) 27°K (b) 127°K (c) 300°K (d) -27°K

10. The amount of energy in food is measured in:

    (a) degrees (b) calories (c) grams (d) milliliters

11. If cooking oil has a specific gravity of 0.85, how much will 1 liter of the liquid weigh?

    (a) 850 grams (b) 8.5 grams (c) 85.0 grams (d) 0.85 grams

12. How much will 25 ml of detergent weigh if it has a density of 1.2 g/ml?

(a) 25 grams (b) 30 grams (c) 50 grams (d) 300 grams

13. A pecan was burned in a calorimeter, raising the temperature of 100 ml of water 66 degrees. How many calories of heat were given off?

(a) 100 (b) 66 (c) 660 (d) 6,600

14. We usually measure body temperature on the:

(a) Centigrade scale (b) Fahrenheit scale

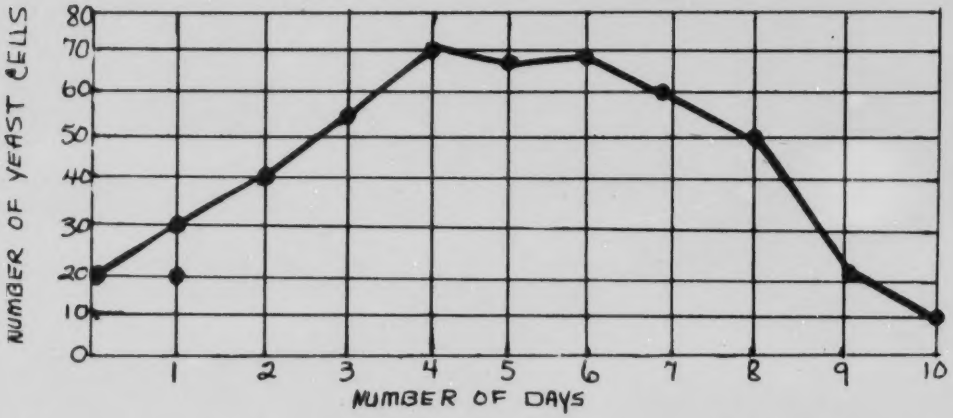
(c) Absolute scale (d) All of these

15. A device used to determine mass is the:

(a) Meter stick (b) Graduated cylinder

(c) Balance (d) Thermometer

A few grains of yeast were placed in a culture medium and allowed to grow for ten days. The number of cells were counted each day and the average number of cells per high power field were plotted on a graph. Interpret the graph below by answering the following questions:



16. The graph shows that the number of yeast cells <u>increased</u> from:

(a) day 4 to day 6 (b) day 6 to day 10

(c) day 0 to day 4 (d) day 0 to day 10

17. The period of time when the greatest <u>decrease</u> occurred was from:

(a) day 0 to day 2 (b) day 8 to day 10

(c) day 4 to day 6 (d) day 6 to day 8

18. If it was determined that a toxic substance was causing a decrease in numbers, you could probably cause an increase again by:

(a) removing yeast cells on day 6

(b) removing the liquid on day 6

(c) adding new culture medium on day 1

(d) adding new culture medium on day 6

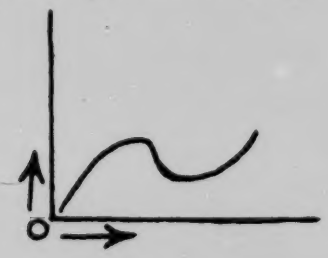
19. If you saw a graph like the one below, you would say that the cells:

(a) increased, decreased, increased

(b) decreased, increased, decreased

(c) increased, decreased, decreased

(d) increased, increased, decreased



20. It is important that students learn to use the metric system because:

(a) it is easy to use

(b) it can be used worldwide

(c) the U.S. will change to the metric system soon

(d) all of the above are true

INSTRUCTIONAL MATERIALS

Metric Rulers

Meter Sticks

Thermometers, Celsius

Thermometers, Clinical, Oral

Balances

Weight Sets

Graduated Cylinders

Corks

Metal Cans for Calorimeters

Tin Snips

Assorted Nuts and Dried Foods

Dropping Pipettes

FILMS:

"Measuring and Testing Things"

"Density"

"Measuring Short Distances"

References

Dull, Charles E., H. Clark Metcalf and John E. Williams. Modern Physics. New York: Holt, Rineheart, and Winston, Inc., 1964.

Oxenhorn, Joseph. Pathways in Science: Matter and Energy. New York: Globe Book Company, Inc., 1969. Book 2.

INSTRUCTIONS FOR COMPLETING UNIT REVIEW SHEET

A. Heading Information:

1. Course: Enter the name of Interest-Based Curriculum Area, for example, Science for Homemakers.

2. Teacher: Enter name of the teacher managing the instructional activities.

3. Unit Title: Enter title of the unit, for example, Common Fractions .

4. Beginning Date: Enter date unit was begun.

5. End Date: Enter date unit was completed.

I. Time Spent on Unit

Objectives: Enter the number(s) of the process-task level objectives covered, not the interim-performance objectives.

Estimated Time: Enter the estimated time for completion of each process/task objective in terms of class periods. This should be done before the unit is begun.

Actual Time: Enter the number of class periods actually used to complete the objective.

Date Completed: Enter date of the last class period spent on the task objective.

II. Objectives Covered

A. If all objectives in the unit were covered, check "yes"; if not, check "no."

B. If all objectives were not covered, list objectives by number and indicate reasons why they were not covered.

III. Appropriateness of Objectives

A. Consider the objectives, the activities, the instructional materials, and the evaluative materials. If all were appropriate for your students, check "yes." If either the objectives, the activities, materials, or evaluation were not appropriate, check "no."

B. List the number(s) of the objectives which were not appropriate--or for which materials, activities, or evaluation materials were not appropriate--and give reasons.

IV. Write any suggestions you think would improve any part of the unit.

Natchitoches Parish Schools

UNIT REVIEW SHEET

Course_____ Teacher_____

Unit Title_____ Date_____

Beginning Date_____ End Date_____

I. Time Spent on Unit

Objectives	Estimated Time	Actual Time	Date Completed	Comments

II. Objectives Covered

A. Covered all objectives: Yes _____ No _____

B. Objectives not covered:

Objective Number	Reasons

III. Appropriateness of Objectives, Activities, Materials, and Evaluation.

A. All objectives were appropriate: Yes _____ No _____

B. Objectives not appropriate:

Objective Number	Reasons
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

IV. Suggestions for Improving the Unit

_____

_____

_____

_____

_____

_____

UNIT 2

HOUSE CARE SCIENCE

HOUSEHOLD CHEMISTRY

UNIT II
Household Chemistry

2-0-0 Upon completion of this unit the house care student will demonstrate a knowledge of household chemistry, as evidenced by at least a 70% score on a teacher-made test.

2-1-0 In five to eight class periods the project teacher will provide activities that distinguish the three states of matter as documented on the project monitorial system.

2-1-1 Demonstrate the diffusion of a liquid into air. Open a bottle of peppermint oil or oil of cloves before the class enters the room. Discuss molecular motion and diffusion, only after someone mentions the odor. Butyric acid gives off an unpleasant odor, so this might be used as a variation of the above. (Has odor of stale butter)

2-1-2 The film "Diffusion and Osmosis" may be shown at this time.

2-1-3 The film "Molecular Motion" is appropriate and lends itself well to discussion of molecular theory.

2-1-4 Do Experiment #1 - "Diffusion of a Solid into a Liquid"

2-1-5 Show the film, "Solutions".

2-1-6 Discuss the three states of matter: solids, liquids, and gases.

2-1-7 Prepare a list of new commercial products being advertized on television, in newspapers and magazines.

2-1-8 List ten common materials used in the home. Give the properties of each that makes it suitable for its use.

2-2-0 In ten to twelve class periods the project teacher will provide activities leading the student to define and distinguish between elements, compounds, and mixtures, as documented on the project monitorial system.

2-2-1 Cover the labels of the containers of the following elements: aluminum, carbon (graphite), sodium, sulfur, lead, tin, iodine, copper, iron, potassium, mercury, nickel, antimony, zinc, and magnesium. Set them on the table and have the students list the physical properties of each, using color, shape, hardness, etc.

2-2-2 Mix 10 grams of table salt with 10 grams of white sand. Recover each by dissolving the salt in water, filtering out the sand and evaporating the water.

2-2-3 Do Experiment #2 to discover how properties are used to identify substances.

2-2-4 Find the density of some substances. Do Experiment #3.

2-2-5 Investigate chemical and physical properties. Do Experiment #4.

2-2-6 Distinguish between mixtures and compounds. Do Experiment #5.

2-2-7 Burn some magnesium ribbon. Examine the residue.

2-2-8 Show and discuss the film, "Elements, Compounds, and Mixtures".

2-2-9 Discuss writing chemical formulas and equations.

2-2-10 Consult a table of elements, symbols, and atomic weights. Make a list of those elements you are already familiar with.

2-2-11 Do Experiment #6 - Writing Chemical Equations.

2-2-12 Test

2-3-0 In twenty-five to thirty class periods the project teacher will provide examples and activities enabling the student to apply the theories, ideas, and principles of chemical reactions, as documented on the project monitorial system.

2-3-1 Discuss the discovery of the gas, oxygen. Describe the experiments done by Priestly and Lavoisier.

2-3-2 Do Experiment #7 - Preparation of Oxygen.

2-3-3 Discuss the effect of oxygen on the combustion of household materials.

2-3-4 Demonstrate several types of fire extinguishers. Tell how they could be used in the home to put out electrical, grease, or cleaning fluid fires. Refill a soda-acid fire extinguisher.

2-3-5 Do Experiment #8 - The Properties of Oxygen.

2-3-6 Do Experiment #9 - Metallic Oxides.

2-3-7 Do Experiment #10 - Hydrogen From Water.

2-3-8 Discuss how an explosion differs from burning.

2-3-9 Discuss the household uses of sodium hydroxide formed in the previous experiment.

2-3-10 Do Experiment #11 - Finding the Molecular Weight of Oxygen.

2-3-11 Do Experiment #12 - Percentage of Oxygen in Potassium Chlorate.

2-3-12 Do Experiment #13 - Properties of Acids.

2-3-13 Do Experiment #14 - Properties of Bases.

2-3-14 Do Experiment #15 - Neutralization.

2-3-15 Demonstrate water of hydration by heating blue copper sulfate crystals to a temperature slightly above the boiling point of water.

2-3-16 Place 10 grams of sodium sulfate crystals on a watch glass and counterpoise it on a balance. The loss of water when the crystals are exposed to air demonstrates efflorescence.

2-3-17 Put 10 grams of calcium chlorides on a watch glass as in the previous activity. The gain in weight (water) illustrates deliquescence.

2-3-18 Name the nine different types of solutions.

2-3-19 Name five common solvents and tell what each dissolves.

2-3-20 Take 10 pieces each of red and blue litmus paper home overnight and make a list of household solutions that are acid or base.

2-3-21 Decide how you would test the soil in your garden or lawn for pH. Test some soil samples.

2-3-22 Test

2-4-0 In ten to twelve class periods the project teacher will provide activities leading the student to discover the importance of chemical substances and their reactions in the home as documented on the project monitorial system.

2-4-1 Read and discuss the handout sheet , "Soap Making".

2-4-2 List the chemical ingredients of three or more common detergents.

2-4-3 Discuss the importance of biodegradable phosphates in detergents.

2-4-4 Do Experiment #16 - Soap Making.

2-4-5 Discuss various metal cleaners and methods of cleaning brass, copper, silver, and stainless steel items found in the home.

2-4-6 Do Experiment #17 - Cleaning Silver.

2-4-7 Discuss the problems of removing stains from different kinds of fabrics.

2-4-8 Do Experiment #18 - Solvents and Stain Removers.

2-4-9 Do Experiment #19 - Testing for Nutrients in Foods.

2-4-10 Do Experiment #20 - Deodorants.

2-1-4 Experiment #1: Diffusion of a Solid into a Liquid

OBJECT: To observe the rate of diffusion of a solid into a liquid

PROCEDURE: Secure two large graduated cylinders and fill about three-fourths full of water (H_2O). Using a piece of glass tubing or other device, insert a tablet, or several granules of potassium permanganate ($KMnO_4$) into the bottom of each cylinder. (Be careful that little or none of the $KMnO_4$ dissolves as it is placed in the water. Why?) Place one of the cylinders in the refrigerator and the other on a table where it will be undisturbed. Label A and B.

Make daily observations and record data. Use centimeters.

OBSERVATION:

RATE OF DIFFUSION OF $KMnO_4$ into H_2O

DATE OF OBSERVATION	CYLINDER A	CYLINDER B

Brief description of what you observed:

EXPLANATION:

2-2-3 Experiment #2: Properties

OBJECT: To learn what properties are commonly used to identify substances

MATERIALS: Crystals of copper sulfate, salt, powdered calcium sulfate, ammonium hydroxide solution, sodium hydroxide solution, hydrochloric acid

PROCEDURE: A substance is usually identified by one or more of its distinguishing properties. These are color, odor, taste, solubility in water or other solvent, density, hardness, crystalline shape, combustibility, melting point, etc.

I. Color

1. Examine a crystal of copper sulfate. What is its color?
2. Grind it into a fine powder. (Use a clean, dry mortar) Is there a change in color?
3. Is color always a reliable property for identification? Explain.
4. If copper sulfate is to be described as a blue substance, what must be the conditions under which it is to be observed?

II. Odor (Use the protective method of discovering odors described by your instructor. Remember some gases may be poisonous.)

5. Describe the odor, as clearly as possible, of ammonium hydroxide, NH_4OH.
6. How does your description compare with others in the laboratory?

III. Taste

7. Dissolve a pinch of salt in ½ test-tube of water. Dip a clean finger into the solution and touch it to the tongue. Describe the taste.
8. Put five drops of hydrochloric acid, HCl, into 20 cc of water and describe the taste.
9. Describe the taste of a solution of lye (sodium hydroxide, NaOH) diluted in the same way. (All solutions should be quite diluted when tasted. Do not swallow the tasted substance. Never taste any solution unless directed to do so by the instructor or your lab manual.)

IV. Solubility

10. Add 1 gram of salt to 50 cc of water. Shake until the salt disappears. Is salt soluble?
11. Add 1 gram of pure calcium sulfate powder to 50 cc of water in a beaker. Shake and let stand for 5 minutes. Is there a visible result? Now filter the solution. The insoluble mass left is the residue and the clear solution which runs through the paper is the filtrate. Evaporate the filtrate to dryness.
12. Is there a residue left? This is a method used to find whether or not a salt dissolves when the solubility is too small to be observed directly.
13. Explain.

2-2-4 Experiment #3: Density

OBJECT: To learn how to determine the density of liquids and solids

MATERIALS: Balances, weights, graduated cylinders, cylinders of metal, blocks of wood, alcohol, pieces of marble or rocks

PROCEDURE:

A. Of liquids: Weigh a graduated cylinder and wipe it dry inside as well as possible. Weigh it very carefully. Record the weight. _____ Fill the graduate to the limit of its graduations with water and read the volume accurately. Read the bottom of the curved surface of the water, the meniscus. Weigh the graduate with the water, to find the weight of the water. Record the weights and volume.

(1) Wt. of graduate and water _____g
(2) Wt. of graduate _____g
(3) Wt. of water _____g
(4) Vol. of water _____cc

$$(5)\ \frac{\text{Wt. of water}}{\text{Vol. of water}} = \text{density}$$

Repeat using alcohol. Do calculations on back.
_____ = density of alcohol

B. Of solids: Measure a rectangular block of wood, recording its dimensions in centimeters. Record its volume. _____ Weigh it. _____ What is its density? _____ In like manner, find and record the density of an iron cylinder. (volume equals $3.14r^2$ x length)

Diameter _____ Length _____ Weight _____
Radius _____ Volume _____ Density _____

The volume of irregularly shaped objects is difficult to find so a different method is used. When an object sinks in water it displaces its own volume of water. The apparent increase in the volume of water is the volume of the object. Find the volume of an object by using a graduate cylinder. Record the increase in the volume of water caused by dropping in the rock or marble.

Vol. of water and solid _____cc
Vol. of water _____cc

Vol. of solid _____

Do you need the weight to calculate the density? Why?

What is the density?

2-2-5 Experiment #4: Chemical and Physical Properties

OBJECT: To determine what is meant by chemical and physical properties

MATERIALS: Roll sulfur, carbon disulfide, dilute hydrochloric acid, zinc, hammer anvil or heavy iron, test-tubes, watch glass, evaporating dish, asbestos mat
CAUTION: Keep carbon disulfide away from all flames.

PROCEDURE: I. Sulfur

A. Physical properties

1. Color _____ 2. Odor _____ 3. Taste _____
4. Shake a small quantity of sulfur in 5 cc of carbon disulfide. Does it dissolve? _____ Pour the clear solution on a watch glass and allow it to stand. Examine the residue on the evaporation of the liquid. What does it appear to be?
5. In exhibiting the physical property of solubility in carbon sulfide, did a new substance form?

B. Chemical properties

6. Place a small pinch of sulfur on an asbestos mat and ignite it. Does it burn? _____ Describe the flame. _____
7. Describe the odor of the gas liberated.
8. Is the sulfur destroyed when it burns?
9. Place a small quantity of sulfur in 2 cc of dilute hydrochloric acid. Is there any apparent action?
(Note that sulfur remains sulfur while exhibiting its physical properties, but in exhibiting its chemical properties, it disappears and becomes something else with a new set of properties.)

II. Zinc

A. Physical properties

1. Scrape a piece of zinc and describe its luster.
2. Try bending it.
3. Pound a small piece into as thin a sheet as possible. Is zinc malleable?

B. Chemical properties

4. Place a small piece of zinc in 5 cc diluted hydrochloric acid. Is there any action? _____ If there is, describe it. _____
5. Does the liberated gas have an odor? _____
6. When the action is over, filter and evaporate the filtrate in an evaporating dish by heating it gently. Describe the residue.
7. Is the residue zinc or a new substance?
8. Give reasons for your answers. _____
9. When a substance undergoes a change whereby a new substance is formed, it has undergone a chemical change. When zinc is acted on by hydrochloric acid, is the action a chemical or physical change?
10. Explain.

2-2-6 Experiment #5: Mixtures and Compounds

OBJECT: A study of what constitutes a mixture and a compound and their outstanding differences

MATERIALS: Zinc (powdered), flowers of sulfur, diluted hydrochloric acid, hand lens, carbon disulfide (Keep carbon disulfide away from flames.)

PROCEDURE: Place two grams of sulfur on a piece of paper and add one gram of zinc. Mix them thoroughly and divide into two portions, A and B.

A. Mixture

1. Examine part A with a microscope or hand lens. Is the zinc still present as it formerly was, and is the sulfur apparently still flowers of sulfur?
2. To half of A add 5 cc of carbon disulfide. Shake. Allow it to stand for a few seconds and decant off the clear solution in a watch glass and warm gently until the liquid has evaporated. Examine the residue. What is it? Does it contain any zinc?
3. Examine the residue in the bottom of the test-tube. What is it? When a compound dissolves, the dissolved material has the same composition the material had before being dissolved. Is it a mixture or a compound?
4. In the previous exercise, we found the action of acid on both sulfur and zinc. Add 10 cc of diluted sulfuric acid to the remaining half of A. Result?
5. What is left after the action is over?
6. Do the sulfur and zinc behave as they did separately in the previous experiment?

B. Compound

1. Place mixture B on an asbestos mat. Stand at arms length and ignite the mixture with the bunsen flame. Results?
2. Examine the residue. Describe it.
3. Does it apparently contain sulfur? Zinc?
4. To half of the residue add 5 cc sulfuric acid. Describe the odor of the gas liberated.
5. Did the mixture in No. 4 above give such a result?
6. If neither zinc nor sulfur gives such a result as this, then how would you account for the results you obtained?
7. Warm the solution until all action has ceased. Does sulfur remain in solution as in A above?
8. Does the residue act as if sulfur or zinc is present or as if a new substance is present? Explain.
9. Filter and evaporate filtrate in an evaporating dish to see if you have zinc or sulfur left. Results?
10. Sum up you reasons for thinking that the residue is a compound of zinc and sulfur, rather than a mixture?

2-2-11 Experiment #6: Writing Chemical Equations

OBJECT: To give practice in writing equations and to review the solubility rules

MATERIALS: Solutions of lead nitrate, potassium chromate, lead acetate, sodium iodide, mercurous nitrate, mercuric nitrate, bismuth chloride, hydrogen sulfide water, antimony chloride, barium chloride, sodium phosphate, ferric sulfate, potassium hydroxide (diluted), aluminum sulfate, diluted ammonium hydroxide, diluted sulfuric acid

PROCEDURE: Find the solubility of each product from the solubility table in the appendix of the text. Record the color of all precipitates formed under the precipitate and also indicate with arrows the precipitates and gases formed. To 3 cc of the first solution add 3 cc of the second. Complete and balance the equation for each. Write word equations and write formulas and balance the equations.

1. Lead nitrate + potassium chromate ⟶ +

   \+ ⟶ +

2. Lead acetate + sodium iodide ⟶ +

   \+ ⟶ +

3. Mercurous nitrate + potassium chromate ⟶ +

   \+ ⟶ +

4. Mercuric nitrate + sodium iodide ⟶ +
   to mercuric nitrate add a few drops of sodium iodide

   \+ ⟶ +

5. Bismuth chloride + hydrogen sulfide ⟶ +

   \+ ⟶ +

6. Antimony chloride + hydrogen sulfide ⟶ +
   use 15 cc of the hydrogen sulfide water

   \+ ⟶ +

7. Barium chloride + sodium phosphate ⟶ +

   \+ ⟶ +

8. Barium chloride + potassium chromate $\longrightarrow$ +

\+ $\longrightarrow$ +

9. Ferric sulfate + potassium hydroxide $\longrightarrow$ +

\+ $\longrightarrow$ +

10. Aluminum sulfate + ammonium hydroxide $\longrightarrow$ +

\+ $\longrightarrow$ +

2-3-2 Experiment #7: Preparation of Oxygen

OBJECT: To prepare oxygen, the most active part of the air and a constituent of oxides

MATERIALS: Lead dioxide, mercuric oxide, iron oxide, manganese dioxide, oxone or sodium peroxide, hydrogen peroxide, splints, potassium chlorate, potassium permanganate, diluted sulfuric acid, medicine dropper

PROCEDURE:

Preparing oxygen from oxides

1. Heat 1 gram of mercuric oxide in a test-tube strongly. Insert a glowing (not burning) splint into the test-tube. If oxygen is liberated the splint will glow brighter or burst into flame. Is oxygen being liberated?

   Mercuric oxide $\xrightarrow{\text{heat}}$ mercury + oxygen

   $2\ HgO \longrightarrow 2\ Hg + O_2$

2. Heat 1 gram of lead dioxide in a test-tube as above. Test for oxygen. Is it leberated?

   Lead dioxide $\xrightarrow{\text{heat}}$ lead monoxide + oxygen

   $2\ PbO_2 \longrightarrow 2\ PbO + O_2$

3. Examine the solid left in the test-tube when cooled. Is it lead? What evidence have you that lead monoxide is not decomposed by heating?

4. The metallic oxides that decompose by heating are the exceptions rather than the rule. To get further proof of this statement, heat iron oxide. Test for oxygen. Is it liberated? Heat manganese dioxide moderately and test for oxygen. Is oxygen liberated?

5. Put a piece of oxone (commercial Na_2O_2) the size of a pea into a dry test-tube. Add a few drops of water from a medicine dropper and test quickly for oxygen. Is it liberated?

   Sodium peroxide + water $\longrightarrow$ sodium hydroxide + oxygen

   $2\ Na_2O_2 + H_2O \longrightarrow 4\ NaOH + O_2$

6. Pour 2 or 3 cc of hydrogen peroxide into a test-tube and add 2 drops of diluted sulfuric acid and a few crystals of potassium permanganate and test for oxygen. Is it liberated? Both are rich in oxygen and liberate a portion. The reaction is complex.

   The dioxides used in parts 2, 4, 5, and 6 liberate but one atom of oxygen per molecule. This is the general rule for the dioxides that liberate oxygen.

   Salts rich in oxygen may liberate it as does potassium permanganate in part 6. Chlorates are most commonly used in the laboratory for obtaining oxygen.

7. Heat 1 gram of potassium chlorate, $KClO_3$, in a clean test-tube. Insert a glowing splint, but not far enough to touch the molten $KClO_3$. Is O_2 liberated?

CAUTION: Sodium or potassium chlorate mixed with a combustible material form an explosive mixture that may be set off by slight friction. Never mix a chlorate with anything unless told to do so.

8. Heat the chlorate strongly for five minutes, then cool. Remove the white solid which is left and taste by touching to the tongue. What does it taste like? Taste a crystal of $KClO_3$. Does the white solid after heating have the same taste? What two facts lead you to believe that a chemical change has taken place?

Potassium chlorate $\longrightarrow$ potassium chloride + oxygen

$2\ KClO_3 \longrightarrow 2\ KCl + 3\ O_2\uparrow$

Do chlorates give up all of their oxygen?

2-3-5 Experiment #8: The Properties of Oxygen

OBJECT: To learn several of the properties of oxygen

MATERIALS: Asbestos paper, combustion spoons, splints, manganese dioxide, magnesium ribbon, potassium chlorate, sulfur, red phosphorus, iron picture wire, small candles, sand

PROCEDURE:

Set up the apparatus shown in the drawing. Mix 6 grams of $KClO_3$ and 2 grams of MnO_2. Do not have the test-tube more than half full and do not allow the mixture to touch the stopper. Fill 6 wide mouth bottles with with water and invert in the trough as shown. Heat the mixture and allow the first gas to escape. Why? Now slip the mouth of a bottle over the end of the delivery tube. As soon as the bottle is full, slip it to one side and put another in place.

While the second is being filled, place a glass plate under the mouth of the filled bottle and set the bottle right-side-up on the desk. Collect at least 6 bottles of gas. Disconnect the delivery tube when you stop heating. Why should you do this?

Note the color of the oxygen that has been standing for at least 30 minutes. Is pure oxygen colorless? If it appears smoky, is the color due to oxygen or to impurities? Invert a bottle of the gas in a beaker of water. If the oxygen dissolves the water will rise in the bottle. Is oxygen soluble? By means of a wire, lower a candle into a bottle of oxygen. Results? Do not handle phosphorus with your fingers. Place a small piece of phosphorus, P, in a cold combustion spoon, lined with asbestos. Ignite the phosphorus with a warm glass rod or burner flame and thrust into a bottle of oxygen. Result?

Phosphorus + oxygen $\longrightarrow$ phosphorus pentoxide

$4\ P + 5\ O_2 \longrightarrow 2\ P_2O_5$

Repeat the same procedure, using sulfur instead of phosphorus. What compound is formed?

Sulfur + oxygen $\longrightarrow$ sulfur dioxide

$S + O_2 \longrightarrow SO_2$

Cover the bottom of a bottle of oxygen with sand. Spread the wires of a piece of picture wire or steel wool and heat until red-hot. Dip quickly into flowers of sulfur which should ignite the wire. Lower into the bottle containing sand. Result? The black ash is iron oxide. Is it brittle? What was the sand for? Why is sulfur placed on the wire?

2-3-6 Experiment #9: Metallic Oxides

OBJECT: (a) To learn that a new substance with a new set of properties is formed when metals combine with oxygen
(b) To study a few properties and uses of metallic oxides

MATERIALS: Copper oxide, ferric oxide, calcium oxide, lead dioxide, magnesium oxide, lead monoxide, mercuric oxide, zinc oxide, iron nails, magnesium ribbon, rusty iron

PROCEDURE:

I. Preparation of oxides

(a) By direct union of a metal with oxygen

1. Examine a piece of magnesium ribbon. Hold it with iron forceps and put one end in a flame until it ignites. Describe what happens.
2. Observe the ash formed by the burning magnesium and state its properties.
3. What is the evidence that magnesium, when burned, undergoes a chemical change?

(b) Hold a bright nail with forceps and heat it in the tip of a Bunsen flame. Iron oxide forms on the surface.

4. Describe the color change. Does it remind you of "blued steel"? Obtain a piece of rusty iron. Examine the rust (largely an oxide). Compare the rust with bright metallic iron color, hardness, brittleness, etc.
5. How does this oxide (rust) compare or differ from the oxide of iron in the preceding experiment?
6. Rouge is an oxide of iron. Is it like other iron oxide? Describe it pointing out differences and resemblances.

(c) The oxides of lead are difficult to obtain or prepare, so examine these set out by the instructor.

7. Describe the oxides of lead that are provided.
8. What differences are apparent?

II. Stability of oxides

(a) Stable oxides

9. Heat a little iron oxide in a hard glass test-tube. Is there a visible change?
10. Examine when cold. Is the substance the same now as it was at first?
11. Heat a little calcium oxide. Does it change? Why do you consider ferric oxide and calcium oxide stable compounds?

(b) Unstable oxides - Heat a little brown oxide of lead in a test-tube. Note the changes.

12. Describe fully what happens.

III. Solubility of metallic oxides

(a) Boil a pinch of copper oxide in water (20 cc). Filter and evaporate 10 cc of the clear liquid to see if any copper oxide has dissolved. What do you conclude? (See p. 657 in text, Chemistry for the New Age)

2-3-7 Experiment #10: Hydrogen from Water

OBJECT: To displace hydrogen from water

We have already learned that zinc will replace the hydrogen from sulfuric acid, or hydrochloric acid. In general, many metals replace hydrogen from acids. The purpose of this experiment is to show that sodium, a metal, will replace the hydrogen from water. Other metals will replace the hydrogen from water but not at ordinary temperatures. Much heat will be generated as the hydrogen is liberated, in fact, so much heat may be generated that an explosion might result. Be careful, especially when handling the sodium, as it frequently burns in the presence of moisture or water. Do not touch the sodium with your bare hands. Always hold it away from your body.

MATERIALS: Glass rod, tweezers, filter paper, sodium (Na), and sodium hydroxide solution (1:10)

PROCEDURE: Fill a test-tube about half full of water and support it with a clamp on the ringstand. Then with tweezers place in a folded piece of filter paper, a fresh piece of sodium about the size of a grain of rice and press out the oil. Holding the sodium at arms length, drop it into the test-tube containing water. Immediately bring a flame to the mouth of the tube. What happens? How is the gas produced? Press another piece of sodium and place it in the test-tube. How does it act? What evidence is there that heat is produced? How is the production of head in this case an evidence of chemical action?

Test the water solution in the test-tube as follows:

1. Using a glass rod remove a drop of the solution and taste it. Describe the taste.

2. Feel the liquid by rubbing it between your fingers. How does it feel?

3. Dip the end of a clean glass rod in the solution and then in a colorless or blue flame. Does it affect the color of the flame? The color is due to the presence of the element sodium.

Dilute 1 ml of a solution of sodium hydroxide with 10 ml of water and repeat the above tests. What do the results show about the composition of the liquid in the test-tube?

Complete the following:

Metals, such as iron, zinc, and magnesium, commonly displace _____ from compounds. Any metal which displaces _____ from dilute acids will also displace it from water, but the reaction will take place only at higher temperatures. In the case of very active metals, such as sodium, which acts at ordinary temperatures, _____ is displaced and the hydroxide of the _____ is formed.

2-3-10 Experiment #11: Molecular Weight of Oxygen

OBJECT: Every element, as you know, has an atomic weight and a molecular weight, and every compound has a molecular weight. These weights have been determined by long and accurate experimentation. The purpose of this experiment is to illustrate a method of determining the molecular weight of an insoluble gas. Such a method, of course, could not be used for determining the molecular weight of gases that are soluble, such as ammonia or hydrogen chloride. This is the most difficult experiment you have performed and it is necessary to be careful to record the weights accurately. Also be sure to drive off all of the oxygen.

MATERIALS: Ring stand, test-tube clamp, wide mouth bottle and delivery tube, potassium chlorate, and powdered manganese dioxide

PROCEDURE: Arrange the apparatus as you did for collecting oxygen, except use a five pint acid bottle for the collection of the gas. Fill the tube 1/3 full of potassium chlorate. Add a small quantity of manganese dioxide, and tap the tube gently to mix the contents. Then weigh the tube and record the weight in the table that follows. Next, attach the dilivery tube and bring the flame under the contents of the test-tube. Remove and replace the flame so that the bubbles of oxygen pass very slowly into the collection bottle. When the bottle is about 3/4 full, discontinue the heating and allow the apparatus to cool. As soon as the apparatus has thoroughly cooled, take the temperature of the water, ask the instructor for the barometer reading, and make the necessary records. Hold the collection bottle vertically and adjust its height so that the level of the water inside is the same as that on the outside. If necessary, put more water in the trough. Next, slip a glass plate tightly over the mouth of the bottle, lift the bottle from the trough and set it upright on the table. Then, using a graduate, fill the bottle with water and measure the quantity required. This quantity is the same as the volume of oxygen collected. Weigh the tube and contents a second time and record the weight. Make all of the computations necessary and complete the following table.

(a) Volume of oxygen collected . . . . . _____

(b) Temperature of the water (or oxygen) . . . . . _____

(c) Barometric reading . . . . . _____

(d) Corrected barometric pressure (correct for vapor tension)_____

(e) Volume of oxygen under standard conditions (General Gas Law)
_____

(f) Weight of tube and contents before heating . . . . . _____

(g) Weight of tube and contents after heating . . . . . _____

(h) Weight of oxygen evolved . . . . . _____

(i) Weight of one liter of oxygen (calculate from e and h) _____

(j) Weight of 22.4 liters of oxygen . . . . . _____

(k) Molecular weight of oxygen . . . . . _____

Some of the probable causes of error in this experiment are:

Interesting observations are:

2-3-11 Experiment #12: Percentage of Oxygen in Potassium Chlorate

OBJECT: To find the percentage of oxygen in potassium chlorate.

MATERIALS: Small crucible, balance, splints, manganese dioxide, potassium chlorate

EXPLANATION: When two or more elements combine chemically, they combine according to a fixed relationship. Two parts of hydrogen by weight, for instance, always unite with 15.88 parts by weight of oxygen to form water. On the percentage basis this means that water is composed of 11.18 percent hydrogen and 88.81 percent oxygen. No matter where water is found, if it is pure, the proportion is always the same. In this experiment you are to determine the composition of potassium chlorate. This substance is used because it readily yields its oxygen, expecially in the presence of manganese dioxide. As you perform the experiment be careful not to lose any of the contents of the crucible or to let any foreign material in. Also, do not stir the contents, as small quantities will stick to the stirring rod.

PROCEDURE: Fill the bottom of a small crucible with powdered manganese dioxide and cover with the crucible cover. Then weigh the crucible. Add enough potassium chlorate to fill the crucible about one-fourth full. Whirl the crucible gently to mix the contents but do not lift it from the table. Weigh the crucible and contents again and record the weight. Now bring the burner under the crucible, applying the heat gently at first and then very strongly. During the intense heating remove the crucible cover frequently to test for oxygen by holding a splint inside the crucible. Make certain that no part of the spling falls into the crucible. Remove the heat about a minute after the glowing splint shows that no more oxygen is being formed. Allow the crucible to cool and weigh as before. Complete the table by making the following calculations.

(a) Weight of the crucible, cover, and manganese dioxide _____g

(b) Weight of crucible, cover, manganese dioxide, & potassium chlorate _____g

(c) Weight of potassium chlorate . . . . . _____g

(d) Weight of crucible & cover after oxygen is driven out _____g

(e) Weight of the oxygen present . . . . . _____g

(f) Percent of oxygen (weight of oxygen divided by weight of potassium chlorate) . . . . . _____g

Interesting observations are:

Conclusions:

The correct percentage ofoxygen in potassium chlorate is 39.16. This figure has been determined by many laboratory experts and checked in a variety of ways. Certain errors in our calculations may be caused by the following things:

2-3-12 Experiment #13: Properties of Acids

OBJECT: To learn some of the properties and characteristics of acids

MATERIALS: Test-tubes, ring stand, burett clamp, burner, wire gause, evaporating dish, splint, litmus paper, filter paper, glass stirring rod, hydrochloric acid, sulfuric acid, nitric acid, mossy zinc, copper oxide, calcium carbonate

EXPLANATION: You have already learned that acids have a sour taste and that they contain hydrogen which may be replaced by a metal or by a positive radical, such as ammonium (NH_4^+). USE CARE IN HANDLING ANY ACID. WASH WITH WATER IF BURNED.

DIRECTIONS: Complete the following.

A. Composition of acids: The formula for hydrochloric acid is _____, for nitric acid it is _____, and for sulfuric acid it is _____. The acids all contain the element _____.

B. Action of acid on litmus: Pour 10 ml of water into each of three test-tubes. Add 2 drops of nitric acid to the first, 2 drops of hydrochloric acid to the second, and 2 drops of sulfuric acid to the third. Using a glass rod, taste a drop of each of the three diluted acid solutions. What taste do you note? _____. Place a drop of each solution on blue litmus paper, and then place a drop of each on a piece of red litmus. What happens? _____

_____

C. Action of acids on metals: Pour 4 ml of water into a test-tube and add 2 ml of hydrochloric to prepare a dilute solution of the acid. Drop a piece of mossy zinc into the test-tube. What gas is formed? _____ Filter off all of the undissolved zinc, pour the solution into an evaporating dish, and carefully evaporate to dryness. What solid remains? _____ The equation for the reaction is as follows: $Zn + 2\ HCl \longrightarrow$ _____ + _____

D. Actions of acids on oxides of metals: Place sufficient copper oxide, CuO, in a test-tube to cover the bottom. Add 1 ml of water and 2 ml of nitric acid. Warm the mixture carefully for a few minutes, making certain that none of it pops out of the test-tube, then cool and filter. Is there any evidence of a chemical change? _____ Explain. Pour the solution into an evaporation dish and evaporate to dryness. The blue solid that remains is copper nitrate, $Cu(NO_3)_2$. Complete and balance the following equation:

$CuO +$ ____ $HNO_3 \longrightarrow$ _____ + _____

E. Action of acids on carbonates: Prepare 5 ml of diluted HCl (1 to 4) and pour into a test-tube. Add two or three pieces of calcium carbonate (marble). Results? _____
The gas evolved is carbon dioxide. Test by thrusting a lighted splint into the mouth of the tube. Evaporate the solution to dryness. The residue is calcium chloride. ($CaCl_2$) Does it dissolve in water? _____ Write an equation for this reaction:

_____

Conclusions: When an acid acts with a metal, such as zinc, _____ is liberated and a new compound is formed, the _____ taking the place of the hydrogen. Such a compound is known as salt. When it acts on a carbonate three substances are formed, _____, _____, and _____.

2-3-13 Experiment #14: Properties of Bases

OBJECT: To study the properties of bases

EXPLANATION: Bases in many cases are directly opposite in properties to the properties of acids. They all contain the hydroxyl group, OH, which is replaceable by a non-metal or a non-metallic radical. In this experiment you will work with sodium metal which is dangerous to handle because it reacts violently in water. Above everything else, do not touch the sodium with your hands. If it ignites, use sand rather than water to put out the flame. Water will only make the flame burn brighter.

MATERIALS: Filter paper, litmus paper, ammonium hydroxide, sodium, calcium oxide (lime), hydrochloric acid solution (1 to 4)

PROCEDURE: Write the formulas for sodium hydroxide, calcium hydroxide, and ammonium hydroxide. All of the bases contain the elements _____ and _____. Prepare a 10% solution of sodium hydroxide and add 1 ml to 5 ml of water in a test-tube. Then taste the solution from the test-tube. Test with litmus paper. Then taste a solution made by adding 1 ml of of ammonium to 10 ml of water. Test with litmus. Taste a concentrated solution of calcium hydroxide ($Ca(OH)_2$). Do these solutions all taste alike? _____ How would you describe the taste? _____ How did the solutions react to litmus paper? _____

Pour the sodium hydroxide solution containing the red litmus paper in an evaporating dish and add hydrochloric acid solution until it does not affect neither red nor blue litmus paper. Evaporate the solution to dryness. Taste the solid that remains. Describe the taste. _____ Write the equation for the reaction between the base and the acid.

_____

Using tweezers for handling, secure a fresh piece of sodium about the size of a grain of rice. Press it into a folded piece of filter paper to remove the oil. Drop it in an evaporating dish about 1/3 full of water. Step back and watch the reaction. The sodium may take fire and spatter you with some of the solution. Test the solution with red and blue litmus paper. How does it feel between the fingers? _____ Write an equation for the reaction, remembering that sodium displaces one-half of the hydrogen in water.

Place a piece of fresh lime, CaO, in a test-tube. Add enough water to cover and allow to stand for five minutes. Test with red litmus paper. Complete the following equation:

$$CaO + HOH \longrightarrow _____$$

2-3-14 Experiment #15: Neutralization

OBJECT: To study neutralization and indicators

EXPLANATION: When an acid is added to a base, the one tends to destroy the chemical properties of the other type of reaction known as neutralization. Usually it is very difficult to determine when the neutral point is reached. About the only means of determination is through the means of indicators. These are chemical compounds which are very sensitive to the presence of acids and bases. Each imparts a certain color in acid solutions and another in bases. As the solution approaches a state of neutralization the color fades. Thus, it is possible to determine exact neutralization when there is neither an excess of acids nor bases. This experiment will familiarize you with the characteristics of certain indicators and prepare you for a direct application of their use in the experiment that follows.

MATERIALS: Test-tubes, test-tube rack, evaporating dish, glass rod, phenolphthalein solution (in alcohol), methyl orange solution (in water), sodium chloride, sodium hydroxide, potassium hydroxide solution (1 to 10), hydrochloric acid (1 to 4)

PROCEDURE:

A. Action of bases on certain indicators - Pour 10 ml of water in each of three test-tubes. Place 1 drop of pholphthalein solution in the first test-tube, 1 drop of methyl orange in the second test-tube, and one drop of congo red solution in the third test tube. Next, place one drop os sodium hydroxide solution in each of the test-tubes. Shake gently and record the color produced in the table.

B. Action of acids on certain indicators - Drop by drop, add diluted hydrochloric acid to each of the test-tubes until the color changes again. Record the colors in the table. Then, drop by drop, add potassium hydroxide solution to each of the tubes until the color changes again. Record the colors in the table. How do the colors produced by potassium hydroxide compare with those produced by sodium hydroxide?

	SODIUM HYDROXIDE	HYDROCHLORIC ACID	POTASSIUM HYDROXIDE
Phenolphthalein			
Methyl orange			
Congo red			

C. Action of indicators at neutralization point - Form a diluted solution of sodium hydroxide in an evaporation dish by adding 5 ml of sodium hydroxide to an equal volume of water. Add a drop of phenolphthalein solution and stir. Then add 2 ml of hydrochloric acid, 1/2 ml at a time. Notice that the solution becomes lighter red in color. Now add more of the acid, drop by drop, stirring thoroughly after each drop. Notice how the color continues to fade. When only a slight trace of the color remains, the solution is near the neutralization point. Cleanse a stirring rod by dipping it into the diluted HCl, shake off any loose drops of acid, and stir the solution in the evaporating dish. If this destroys the last trace of color, the solution is neutral. Evaporate the solution to dryness and taste the residue. What is it? Test a solution of sodium chloride with red and blue litmus paper. What happens?

2-4-1 Soap Making

Many common fats and oils of plant and animal origin are esters. They consist of mixtures of the glyceryl esters of fatty acids. The three fatty acids from which these esters are derived are palmitic acid, oleic acid, and stearic acid. The ester of stearic acid is glyceryl stearate (stearin) and is commonly found in beef or mutton tallow. When stearin reacts with sodium hydroxide, a soap, sodium stearate, is formed. The reaction may be stated as follows:

$$C_3H_5(C_{17}H_{35}COO)_3 + 3\ NaOH \rightarrow 3\ NaC_{17}H_{35}COO + C_3H_5(OH)_3$$

(FAT) (BASE) (SOAP) (GLYCEROL)

This process is known as saponification and an important by-product is glycerol. Sodium hydroxide forms a hard soap and potassium hydroxide forms soft soap. The amounts of fat and hydroxide must be carefully regulated because an excess of the free alkali would be injurious to the skin and an excess of fat would prevent lathering.

2-4-4 Experiment #16: Soap Making

OBJECT: To study the nature of fats (esters) by the formation and decomposition of a single fat

MATERIALS: Cottonseed oil, ethyl alcohol, evaporation dish, sodium hydroxide solution (1 to 2), test-tube, saturated sodium chloride solution

PROCEDURE: Pour 8 ml of cottonseed oil and an equal volume of ethyl alchohol into an evaporation dish and add 1 ml (15 drops) of sodium hydroxide solution (1 to 2). Warm gently and stir until you can no longer see the alcohol. Allow the substance to cool and notice the pasty scum which forms on the surface. This scum is soap, consisting largely of sodium oleate mixed with glycerine.

Dissolve the scum in a small quantity of warm water. Fill a test-tube about half full of the solution and add a small quantity of saturated sodium chloride solution. This action, called "salting out", is an example of coagulating a solid. Identify the product that forms in the liquid just below the soap.

Complete the word equation below:

Fat + sodium hydroxide ⟶ _____ + _____

2-4-6 Experiment #17: Cleaning Silver

OBJECT: To discover a scientific and economical way to clean silver

MATERIALS: Silverware, baking soda, salt, water, soft cloth, aluminum pan

PROCEDURE: Make a solution of one teaspoonful of baking soda and one teaspoonful of salt (NaCl) to a quart of water. Bring the solution to a boil in an aluminum pan. Place the silverware in the pan so that each piece is covered by the solution and touches the pan.

Remove the silver, rinse in clear water and polish with a soft cloth.

EXPLANATION: The silver, touching the aluminum and surrounded by the hot solution, really formed one plate of an electric cell. The tarnish (silver sulfide) was first dissolved. The aluminum (from the pan) replaced the silver in the silver sulfide solution and the silver was redeposited on the silverware.

2-4-8 Experiment #18: Solvents and Stain Removers

OBJECT: To learn how to remove common stains

MATERIALS: Washing soda, water, beaker, bleaching powder, evaporation dish, medicine dropper, oxalic acid solution, test-tube, glass rod, hydrogen peroxide, potassium permanganate, hydrochloric acid

EXPLANATION: Ordinary dry cleaning removes loose dirt, but special attention is required for the removal of spots. Special chemists are employed to give attention to the complex problem of removing spots. Different methods of removal are required for the same substance that causes spots on cotton, wool or silk because of the nature of the materials. This experiment will acquaint you with some of the methods used in spot removal.

PROCEDURE: Dissolve 10 grams of washing soda in 100 ml of water in a beaker and add 10 grams of bleaching powder. Stir. Allow the mixture to settle and filter. The clear solution is a good bleaching solution. When using the solution, stretch the stained portion of a cloth over an evaporating dish or beaker and apply with a medicine dropper or a glass tube. Neutralize the solution with oxalic acid solution and rinse well with water. Repeat as many times as necessary, but do not let the solution remain on the cloth very long at the time. Compare the bleaching action of this solution with that of a commercial bleach.

Dissolve several crystals of potassium permanganate in less than 1 ml of water in a test-tube. Using a glass rod, apply some of the solution to a stain and allow it to oxidize for a few minutes. Apply a few drops of hydrogen peroxide made slightly acid by a drop of hydrochloric acid. Repeat if necessary. Rinse well and explain what happens.

2-4-9 Experiment #19: Testing for Nutrients in Foods

OBJECT: To learn how to test for nutrients in foods

MATERIALS: Bread, test-tubes, water, diluted iodine solution, glucose, Benedicts solution, nitric acid, egg white, ammonium hydroxide, peanut butter, writing paper, ether

EXPLANATION: All foods may be classified as carbohydrates, water, fats, proteins, vitamins, or minerals. All are necessary for a well-rounded diet. In this experiment you will learn how to test to find out what nutrients are present in various foods.

PROCEDURE:

A. Test for starch - Place a small piece of bread or cracker in a test-tube which is 1/3 full of water. Boil vigorously, then allow to cool. Test by adding a drop of very dilute iodine solution. Result? A deep blue color indicates the presence of starch.

B. Test for sugar - Fill a test-tube 1/3 full of water and add about 1/4 teaspoon of glucose. Add to this solution about 1/3 test-tube of Benedict's solution and boil. Result? A yellow to brick-red precipitate indicates the presence of glucose.

C. Test for protein - Pour a few drops of nitric acid on a small piece of cooked egg white. A yellow color indicates the presence of proteins. Rinse with water and add a few drops of ammonium hydroxide. A deep orange color is another indication that protein is present.

D. Test for fats - Place a small amount of peanut butter in a test-tube half full of ether.

CAUTION: DO NOT HAVE FLAMES NEAR YOU DURING THIS EXPERIMENT AS ETHER IS READILY EXPLOSIVE.

Shake the tube to dissolve the fat. Filter the contents into an evaporating dish and allow the ether to evaporate. Press a piece of writing paper on the residue and hold before a light. Results? A translucent spot indicates the presence of fats.

2-4-10 Experiment #20: Deodorants

OBJECT: To produce an effective, safe, and inexpensive deodorant

MATERIALS: Powdered alum, water, rose water or perfume, plastic squeeze bottle

EXPLANATION: Many household items are made from simple, inexpensive chemicals that are readily obtained from a drug or grocery store. Some of these items are expensive because they are packaged in aerosol spray cans. Personal deodorants are among those items in which the ingredients cost only a few cents, but the consumer is charged for expensive packaging and advertising.

PROCEDURE: Mix two or three tablespoons (15 to 20 grams) of powdered alum in a pint (500 ml) of water. Add small quantities of rose water or perfume. Place in plastic squeeze bottle.

2-2-8 UNIT TEST: HOUSEHOLD CHEMISTRY

Directions: Circle the correct answers for the following:

1. The science dealing with the structure and composition of materials and the changes in composition of the materials is:
   (a) biology (b) chemistry (c) mathematics (d) physics

2. The state of matter characterized by having a definite shape and volume is:
   (a) gas (b) fluid (c) liquid (d) solid

3. A homogeneous material which is a mixture is a/an:
   (a) pure substance (b) solution (c) element (d) compound

4. Which of the following cannot be further decomposed by chemical means?
   (a) carbon (b) sugar (c) air (d) water

5. Which of the following is <u>not</u> a property of metals?
   (a) electrical conductor (b) heat conductor (c) brittleness
   (d) luster

6. A diluted solution of household lye will taste:
   (a) sweet (b) bitter (c) sour (d) salty

7. A small piece of zinc was place in hydrochloric acid. This resulted in:
   (a) production of chlorine gas (b) zinc being dissolved
   (c) hydrogen gas given off (d) no reaction

8. The insoluble solid resulting from the mixing of two solutions is called a:
   (a) catalyst (b) precipitate (c) hydrate (d) synthetic

9. A sequence of observations carried out under controlled conditions is:
   (a) a theory (b) a generality (c) an experiment (d) a law

10. A substance having a definite volume, but taking the shape of its container is a:
   (a) liquid (b) gas (c) solid (d) vapor

11. Which of the following represents a compound?
   (a) C (b) Co (c) Ca (d) CO

12. "Every pure compound has a definite proportion by weight." This is the:
   (a) definition of chemistry (b) law of mixtures
   (c) law of definite composition (d) law of compounds

13. What kind of change occurs when magnesium ribbon is burned?
   (a) physical only (b) chemical only (c) nuclear only (d) both chemical and physical

14. The man-made (synthetic) elements are results of :
(a) physical changes (b) nuclear changes (c) chemical changes
(d) none of these

15. A chemical change that liberates heat is called:
(a) endothermic (b) exothermic (c) cryogenic (d) spontaneous combustion

2-3-23 TEST - PART A

Directions: Choose the best answer to the following:

1. Hydrogen may be produced by the reaction between cold water and:
   (a) magnesium (b) iron (c) sodium (d) manganese

2. Oxygen is prepared in commercial quantities from:
   (a) manganese dioxide (b) sodium nitrate (c) potassium chlorate (d) water

3. Hydrogen occurs:
   (a) combined with zinc (b) combined with acids
   (c) free in acids (d) free in water

4. The element having an atomic weight of 16 is:
   (a) hydrogen (b) potassium (c) oxygen (d) nitrogen

5. Solids suspended in water are removed by:
   (a) boiling (b) adding alum (c) adding chlorine (d) adding copper sulfate

6. A water solution of a salt formed by the reaction between a strong base and a strong acid is:
   (a) neutral (b) acidic (c) basic (d) variable

7. A strong acid differs from a weak acid in the:
   (a) amount of dissolved hydrogen (b) number of replaceable hydrogen atoms (c) number of hydrogen ions produced (d) ability to combine with oxygen

8. When a strong acid and a weak base react, the salt produced is:
   (a) acidic (b) basic (c) neutral (d) variable

9. A substance which acts as a catalyst in the generation of oxygen is:
   (a) mercury (II) oxide (b) sodium peroxide (c) potassium chlorate (d) manganese (IV) dioxide

10. A proof that air is a mixture is that:
    (a) its composition varies (b) it can be liquified (c) it supports combustion (d) it becomes warm when compressed

TEST - PART B

1. List three ways of preparing a small quantity of oxygen in the laboratory.
   1. _____
   2. _____
   3. _____

2. List three ways of preparing a small quantity of hydrogen in the laboratory.
   1. _____
   2. _____
   3. _____

3. Why is pure hydrogen not used as a fuel? _____

4. Explain the following: Two bottles of hydrogen were collected by a student. One burned quietly. The other burned with a loud "pop".

5. Write a balanced equation for each of the following:

   (a) Potassium chlorate heated with manganese dioxide

   (b) The electrolysis of water

   (c) Zinc and diluted sulfuric acid

   (d) Sodium and water

   (e) Hydrochloric acid and sodium hydrochloride

MATERIALS
(for each pair of students)

1 beaker, 250 ml, Pyrex, low form

3 bottles, wide mouth, 6 oz., to take No.5 2-hole stopper

1 cork stopper, to fit test-tube

1 evaporating dish, diameter 3 inches

1 flask, Erlenmeyer, 250 ml, Pyrex, to take No.5 2-hole stopper

1 funnel, 2 1/2 inches diameter, 6 inch stem

1 rubber tubing, 15 inches long, 3/16 inch diameter

3 glass plates, 2 1/2 inches by 2 1/2 inches

1 box safety matches

1 one-hole rubber stopper, to fit test-tube

2 two-hole rubber stoppers, No.5

12 test-tubes, 5 inches by 5/8 inch

1 test-tube brush

1 test-tube holder

1 crucible tongs

1 burner and tubing

1 pneumatic trough

1 ring stand

1 buret clamp

1 wire gauze with asbestos center

1 test-tube rack

Chemicals as required

REFERENCES

Garrett, Alfred B., John S. Richardson, and Arthur S Kiefer. Chemistry. Boston: Ginn and Company, 1961.

Greenstone, Arthur W., Frank X. Sutman, and Leland G. Hollingworth. Concepts in Chemistry. New York: Harcourt, Brace, and World, Inc., 1966.

Metcalf, H. Clark, John E. Williams, and Joseph F. Castka. Modern Chemistry. New York: Holt, Rinehart, and Winston, Inc., 1966.

Natchitoches Parish Schools

UNIT REVIEW SHEET

Course _____ Teacher _____

Unit Title _____ Date _____

Beginning Date _____ End Date _____

I. Time Spent on Unit

Objectives	Estimated Time	Actual Time	Date Completed	Comments

II. Objectives Covered

A. Covered all objectives: Yes _____ No _____

B. Objectives not covered:

Objective Number	Reasons

III. Appropriateness of Objectives, Activities, Materials, and Evaluation.

A. All objectives were appropriate: Yes _____ No _____

B. Objectives not appropriate:

Objective Number	Reasons
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

IV. Suggestions for Improving the Unit

_____

_____

_____

_____

_____

_____

UNIT III

HOUSE CARE SCIENCE

HOUSEHOLD ELECTRICITY

UNIT III
Household Electricity

3-0-0 Upon completion of this unit the housecare student will demonstrate a knowledge of principles of electricity, as evidenced by at least a 70% score on a teacher-made test.

3-1-0 In three class periods the teacher will provide experiences and activities leading to a basic understanding of electricity as it applies to household machines, as documented on the project monitorial system.

3-1-1 Read Chapter 1, Pathways in Science: The Forces of Nature, for a discussion of the importance of electrical circuits in the daily life of mankind.

3-1-2 Show film "Electricity: How to Make a Circuit".

3-1-3 Using a knife switch, a 6-volt battery, and a doorbell, make a simple circuit and demonstrate to the teacher that it works properly.

3-1-4 Demonstrate several kinds of switches and show how each works.

3-1-5 Show how an electric circuit is incomplete when a wall switch is in the OFF position.

3-2-0 In four class periods the project teacher will provide activities that lead to an understanding of electric currents, as documented on the project monitorial system. (Chapter 11, Modern Science 3)

3-2-1 Read and discuss Chapter 2, Pathways in Science; The Forces of Nature.

3-2-2 Duplicate Volta's experiment by placing a zinc strip and a copper strip in a solution of table salt and water. Connect the two strips with a galvanometer by means of a copper wire. If the needle moves, it shows a current is flowing.

3-2-3 Repeat the above using solutions of: (a) distilled water, (b) alcohol, (c) sulfuric acid (dilute), and (d) hydrochloric acid.

3-2-4 Will a lemon act as a voltaic cell? Repeat the above using a lemon.

3-2-5 Make a written report on Alessandro Volta.

3-2-6 Open a 1.5-volt dry cell and examine.

3-2-7 Make a list of good conductors.

3-2-8 Make a similar list of non-conductors.

3-2-9 Make a report on how electricity can be produced by light.

3-3-0 In three class periods the project teacher will provide activities enabling the students to experience measuring electric currents and electromotive force, as documented on the project monitorial system.

3-3-1 Read and discuss Chapter 3, Pathways in Science: The Forces of Nature.

3-3-2 Discuss the following:
(a) How is an electric current measured?
(b) What instrument measures the amount of current flowing through a circuit?

3-3-3 Connect the positive end of a dry cell to the plus terminal of an ammeter and the negative end of the battery to the minus terminal. Handle the ammeter carefully and do not pass too much current through it, as this may damage this delicate instrument. Record the amperage.

3-3-4 Connect a voltmeter with a dry cell as in the preceding activity, but place a small switch in the circuit. Close the circuit only during the time a measurement is being taken. Record the voltage.

3-4-0 In three class periods the project teacher will provide activities that describe how parallel and series circuits work, as documented on the project monitorial system.

3-4-1 Read and discuss Chapter 4, Pathways in Science: The Forces of Nature.

3-4-2 Demonstrate a series circuit using Christmas tree lights. Remove one bulb (or loosen it) and decide why the bulbs will not light up.

3-4-3 Connect two bulbs in series and attach to a dry cell. Test the current flowing in the circuit by means of an ammeter. Place the ammeter: (a) between the positive terminal and the first bulb, (b) between the two bulbs, and (c) between the second bulb and the negative terminal.

3-4-4 Place a voltmeter in a circuit with a dry cell. Connect two cells in series and read the voltage. Repeat, using three dry cells.

3-4-5 Connect two batteries, a switch, and a piece of fine fuse wire in series. Close the switch and observe. What is the purpose of fuses in the home? Feel the wire to determine if there is a temperature change.

3-4-6 Household appliances are rated in watts, a unit of power. Watts are the product of the amperage and voltage of a circuit.

WATTS = AMPERES x VOLTS

Fuses are rated in amps, i.e., 15-amps, 20-amps, etc. The current through a 100 watt mixer in 120-volt circuit would be:

$$\frac{100 \text{ watts}}{120 \text{ volts}} = 0.83 \text{ amps}$$

The current through a 60 watt light bulb in a 120-volt circuit is 0.5 amps. How many of these bulbs would have to be used in the circuit for a 20 amp fuse to melt?

3-4-7 Connect three or more bulbs between two parallel lead wires and attach to a dry cell. Loosen one bulb and observe. This is called a parallel circuit.

3-4-8 Connect a voltmeter to one dry cell and record the reading. Connect the positive pole of one dry cell to the negative pole of a second battery, with the voltmeter between the batteries. Record the reading. Place a third battery in the series circuit and read the voltmeter. Repeat the above voltmeter readings with the batteries connected in series. Discuss the change in readings.

3-5-0 In two class periods the project teacher will provide activities enabling the students to define resistance as documented on the project monitorial system.

3-5-1 Read Chapter 6, Pathways in Science: The Forces of Nature, and/or Chapter 11, Modern Science 3.

3-5-2 Discuss several conductors of electricity, showing that good conductors have low resistance and are used as electric wires.

3-5-3 Show that conductors of high resistance get hotter than conductors of low resistance when the same current is applied by the use of several household appliances, such as light bulb, iron, toaster, hot plate, and others.

3-6-0 In one class period the project teacher will demonstrate how to read an electric meter as documented on the project monitorial system.

3-6-1 Using charts, posters, and/or an electric meter, demonstrate how to read an electric meter, determine kilowatt hours used, and compute an electric bill.

3-6-2 Determine the local electric rates by consulting the power company. Using these rates, compute the electric bill if the number of Kwh used per month were: (a) January - 550 Kwh, (b) February - 400 Kwh, (c) March - 600 Kwh, (d) July - 950 Kwh, (e) August - 1000 Kwh, (f) September - 750 Kwh

3-7-0 In one to two class periods the project teacher will provide activities illustrating ways to increase voltage and current as documented on the project monitorial system.

3-7-1 Connect a 3-volt light bulb with a dry cell. Note the brightness of the bulb. Connect another cell in series and again note the brightness. Connect a third cell in series and note the brightness and feel the temperature of the bulb. State in your own words what happens when the number of dry cells in a series is increased.

3-7-2 Place a voltmeter in parallel with each of the above to discover how increasing the number of dry cells increases the voltage.

3-8-0 In one to two class periods the project teacher will provide activities allowing the students to discover how a rheostat works, as documented on the project monitorial system.

3-8-1 Demonstrate the Wheatstone bridge to show that current decreases with an increase in resistance.

3-8-2 Devise a rheostat, using high resistance wire, a dry cell, light bulb, and a board. Show that by moving the electrical wire along the high resistance wire, the resistance changes. Relate the change in current to the volume control on radio or TV and a rheostat switch for lights.

3-8-3 State Ohms Law in your own words.

$$V = RI \quad \text{or} \quad I = \frac{V}{R}$$

3-9-0 In one class period the project teacher will administer the unit test, as documented on the project monitorial system.

3-9-0 UNIT TEST: HOUSEHOLD ELECTRICITY

Choose the best answer.

1. Putting a switch in the ON position:
   (a) opens the circuit (b) breaks the circuit (c) closes the circuit

2. An electric lamp burns because:
   (a) the switch is on (b) a current is flowing (c) the circuit is broken

3. Which of the following is a good conductor of electricity?
   (a) metals (b) non-metals (c) water

4. The inventor of the simple electric cell was:
   (a) Alessandro Volta (b) Alexander Bell (c) John Everready

5. An electric current is a flow of :

   (a) neutrons (b) protons (c) electrons

6. An insulator is a substance through which electrons:
   (a) move freely (b) cannot pass (c) are changed to protons

7. The amount of electric current in a circuit is measured in:
   (a) ohms (b) amperes (c) volts

8. Units of electromotive force are:
   (a) volts (b) amperes (c) ohms

9. In a series circuit, the current:
   (a) is the same throughout the circuit
   (b) increases as it moves away from the source
   (c) decreases as it moves away from the source

10. A protective device for too much current in a circuit is:
    (a) an ammeter (b) a rheostat (c) a fuse

11. Electrical power is measured in:
    (a) amps (b) volts (c) watts

12. A circuit that has several branches is a:
    (a) series circuit (b) parallel circuit (c) resistance circuit

13. A device used to change the amount of resistance and current in a circuit is the:
    (a) rheostat (b) coil (c) switch

14. The electric energy used in the home comes from:
    (a) power plants (b) dry cell batteries (c) the electric meter

15. The unit of measurement for energy used on your electric utility bill is:

(a) joule/sec (b) kilowatt-hours (c) watts-minutes

INSTRUCTIONAL MATERIALS

Description	Quantity
Power Supply Unit	5
Wheatston-Bridge Apparatus	5
Dry Cell Batteries (1 1/2-volts)	10
Galvanometer	5
Ampmeter	5
Voltmeter	5
Knife Switch	5
Lamps (incandescent)	25
Wire, Hook-up # Bell wire	50 ft.

FILMS

"Electricity"

"Electrostatics"

"Ohm's Law"

"Electric Field"

"Elements of Electrical Circuits"

"Electrons and Electronics"

FILMSTRIPS

"Static Electricity"

"The Principles of Electric Motors and Generators"

REFERENCES

Blanc, Sam S. and others. Modern Science 3. New York: Holt, Rineheart, and Winston, Inc., 1963.

Oxenhorn, Joseph M. and Michael N. Idelson. The Forces of Nature, ed. Peter Greenleaf. New York: Globe Book Company, Inc., 1968.

UNIT IV

HOUSE CARE SCIENCE

HOUSEHOLD MACHINES

UNIT IV
Household Machines

4-0-0 Upon completion of this unit the house care student will demonstrate a knowledge of principles of how some household machines work, as evidenced by a score of at least 70% on a teacher-made test.

4-1-0 In five class periods the project teacher will provide activities dealing with static electricity as documented on the project monitorial system.

4-1-1 Show that electrons may be removed from some materials by friction. (Activity 4-1-1)

4-1-2 Demonstrate the electroscope, using a glass rod and silk cloth, and a rubber or Bakelite rod and wool or fur, to charge the foil leaves. Show that it may be charged by induction and conduction.

4-1-3 Demonstrate that paper may be attracted by either a positively or negatively charged rod. Try this with charged rubber combs that have been combed through the hair.

4-1-4 Discuss how lightning is produced by static electricity discharging between clouds and the ground.

4-1-5 Describe lightning rods and tell how they work.

4-1-6 Hang a pair of inflated balloons from short lengths of thread. Rub the balloons with wool. Draw a sketch of the balloons before and after being charged.

4-1-7 Read about electric eels and find out how they produce electric charges.

4-1-8 Find out how electric charges are used to remove dust particles from smoke.

4-1-9 Visit a plant where metals, such as silverware, are electroplated.

4-2-0 In five class periods the project teacher will provide activities illustrating the effects of magnetism and application of the use of magnetism to household machines as documented on the project monitorial system.

4-2-1 Investigate an electromagnet. (Activity 4-2-1)

4-2-2 Make a temporary magnet. (Activity 4-2-2)

4-2-3 Investigate the electric doorbell. Run the doorbell with a 6-volt transformer or 3 or 4 dry cells. How does the electromagnet make the bell ring?

4-2-4 Make a written report on the solenoid. How would you use a solenoid in door chime to lock or unlock a door by remote control?

4-2-5 Set two cans on an insulated surface. Place a bare wire across the top of one can. Charge both cans by induction. Which can holds its charge longer?

4-2-6 Make a simple generator using no. 24 insulated wire, wind a rectangular coil of about 25 turns that can rotate freely between the poles of a U-magnet. Mount the coil on a wooden base and connect it to a galvanometer. Hang the magnet over the coil of wire by a doubled string. Turn the magnet to twist the string, then release it. What effect does this have on the galvanometer? Explain how this principle can be used to furnish power for homes.

4-2-7 Using a hand-cranked magneto, provide alternating current for a neon bulb. Explain your observations.

4-2-8 Construct a model of a DC motor.

4-2-9 Obtain a discarded transformer and note the input and output voltages. Unwind the coils and count the turns.

4-2-10 Write a short history on the development of electric motors and generators.

4-2-11 Make a model of the telegraph using an electromagnet and one or two dry cells.

4-2-12 Obtain an induction coil that has been used in an automobile. Show how you can get sparks with this coil and two or three dry cells.

4-3-0 In two class periods the project teacher will provide activities that lead to an understanding of how electricity is used to obtain heat, as documented on the project monitorial system.

4-3-1 Cut equal lengths of iron and copper wire, connect to one or two dry cells and a switch. Close the switch for five seconds and touch each wire. State your conclusion in a clear, concise sentence. Explain how this principle is used to operate electric heaters.

4-3-2 Take apart some discarded electric heaters, irons, toasters, etc., and compare the metals used in the heating wires.

4-3-3 Read about some of the men that helped develop electricity. Write a report on Edison, Faraday, Westinghouse, and others.

4-3-4 Compile a list of electrical appliances that use resistance to produce heat.

4-4-0 In seven class periods the project teacher will provide activities leading to an understanding of how atmospheric pressure is used in the operation of household machines, as documented on the project monitorial system.

4-4-1 Fill a styrofoam cup with water, placing a cardboard over it. Hold the card in place and turn the cup upside down. The card should stay in place, and the water stay in the cup. Now punch a small hole in the bottom of an empty cup with your pencil. Place your finger over the hole, fill with water and perform the above. If the card stays on the cup, hold it over the sink and remove your finger from the hole. Explain what happens in terms of air pressure.

4-4-2 Demonstrate how a siphon works to remove dirt and water from an aquarium.

4-4-3 Describe, in terms of air pressure, how the following devices work: medicine dropper, plumber's plunger, water pistol, vacuum cleaner.

4-4-4 Connect a vacuum pump to a glass tube. Insert a one-hole stopper in a one gallon metal can and insert the tube into the stopper. Pump out some of the air. Describe and explain the results.

4-4-5 Demonstrate effects of air pressure using the Maydeburg hemispheres. If these are not available, similar results may be obtained using two plumber's plungers. Have a tug of war to try to pull them apart.

4-4-6 Illustrate the idea that steam takes up more space than the liquid to which it condenses. Put a small amount of water in a metal gallon can. Heat until it begins to boil. Screw the cap on tight and hold the can under running tap water. Explain what happens when the steam condeuses.

4-4-7 Make a poster of common household devices that make use of atmospheric pressure.

4-4-8 Write a report on Torricelli and how he proved that air exerts pressure.

4-4-9 Demonstrate and explain the mercurial barometer.

4-4-10 Describe and explain how the aneroid barometer works.

4-4-11 Keep a record of the barometric pressure for a week.

4-4-12 Demonstrate a simple lift pump and decide why it will not lift water higher than about 30 feet.

4-4-13 Tell why you should make two holes in a can of juice.

4-5-0 Unit Test

4-1-1 Activity: Producing Static Electricity

OBJECT: To show that some materials give up electrons easily

PROCEDURE: Secure two Bakelite or Lucite rods and some fur or wool. Rub one rod briskly to transfer electrons onto the rod. Suspend this rod with thread. Rub the other rod with the same material and bring it near one end of the suspended rod. Record your observations. Repeat the above, using a glass rod and silk cloth. What happens when the objects are brought near each other? Suspend the glass rod and repeat the above procedure. Record your observations in the table below.

OBSERVATIONS:

	RUBBER ROD	GLASS ROD
RUBBER ROD		
GLASS ROD		

EXPLANATION: State the law of nature illustrated by this experiment in your own words.

4-2-1 Activity: Electromagnetism

OBJECT: To determine if the strength of an electromagnet is affected by the number of turns in the coil of wire.

MATERIALS: One and one-half-volt dry cell, an 8 foot length of insulated copper wire, soft iron rod, box of paper clips

PROCEDURE: Test the iron bar to determine if it is magnetic. Result? Wind a single turn of wire around the bar. Determine the strength of the electromagnet by touching to paper clips. Record the number of paper clips in the table below. Continue to add coils of wire, testing the strength of the magnetic field each time. Make a graph of your results.

TEST	NUMBER OF TURNS	NUMBER OF CLIPS
1	1	
2	2	
3	4	
4	6	
5	8	
6	10	
7	15	
8	20	
9	30	
10	40	

RESULTS: Does the strength of the magnetic coil increase in direct proportion to the number of turns of wire in the coil?

4-2-2 Activity: Making a Temporary Magnet

OBJECT: To determine the behavior of magnetized iron rods

MATERIALS: Steel knitting needles or hardened flooring nails, a strong permanent magnet, thread, corks, large glass bowl

PROCEDURE: Using the same pole of the magnet throughout, stroke three needles (nails) several times in the same direction. Test to see if they have become a magnet. Result? Using a crayon or colored chalk, mark the north pole of each. Suspend several of the magnets so that they hang horizontally and do not touch each other. Note the position each assumes.

Push a needle through each of three identical corks. Fill a bowl with water and place one magnetized needle in the center. Place a second one beside it and observe. Place the third in the bowl and draw a diagram showing the final positions they assume. Try picking up various objects with the magnet such as a penny, dime, brass screw, and an iron nail. Determine which parts of the magnet have the most strength.

4-5-0 UNIT TEST: HOUSEHOLD MACHINES

1. It is difficult for magnetic force to penetrate:

   (a) iron (b) glass (c) paper (d) rubber

2. Materials that are attracted to magnets are said to be:

   (a) non-magnetic (b) magnetic (c) anti-magnetic (d) neutral

3. Some magnets may have several poles, but most have:

   (a) none (b) one (c) two (d) three

4. The strength of the magnetic field of an electromagnet does not depend on:

   (a) the amount of current flowing through the coils
   (b) the number of turns of wire
   (c) the material of the core
   (d) the direction of the core

5. A magnet will not attract:

   (a) brass screws (b) iron nails (c) steel paper clips (d) lodistone

6. According to modern theory, the charge on an object depends on whether it has gained or lost:

   (a) atoms (b) protons (c) neutrons (d) electrons

7. Suppose that two combs have been rubbed with wool. What will happen if they are brought near each other?

   (a) They will repel each other.
   (b) They will attract each other.
   (c) Nothing happens; they are neutrally charged.

8. When an object that has been charged with static electricity is brought near another object, it becomes electrically charged. This process is:

   (a) galvanizing (b) induction (c) conduction (d) reduction

9. When lightning occurs, billions of electrons move from a negatively charged area to a positively charged area. This is described as:

   (a) slow discharge (b) rapid discharge (c) induced charges
   (d) conductivity

10. The clapper in a doorbell moves back and forth because:

(a) the switch closes the circuit
(b) the current alternates
(c) it is attracted by the electromagnet
(d) it is repelled by the electromagnet

11. The heating element in a toaster gets hot due to opposition to the flow of electricity. This property is called:

(a) conductance (b) insulation (c) frequency (d) resistance

12. Atomspheric pressure is about:

(a) 15 lbs. (b) 76 inches (d) 15 lbs. per $in.^2$ (d) 4 lbs. per $in.^2$

13. Atmospheric pressure is measured by a/an:

(a) thermometer (b) anemometer (c) air pump (d) barometer

14. Why does a metal can collapse when air is removed from it?

(a) The pressure inside is greater than the pressure outside.
(b) The pressure outside is greater than the pressure inside.
(c) A temperature change occurs.
(d) none of the above

15. Which of the following does <u>not</u> make use of atmospheric pressure?

(a) medicine dropper (b) vacuum cleaner (c) doorbell
(d) plumber's plunger

INSTRUCTIONAL MATERIALS

Electroscope

Glass rods

Rubber rods

Silk cloth

Wool or fur

Rubber combs

Toy balloons

Dry cells

Iron nails

Insulated electric wire, #24

Doorbell

Switch

U-magnets

Galvonometer

Hand-cranked magnets

Neon bulb

Discarded transformers

Discarded induction coils

Discarded electric appliances (heaters, irons, toasters, etc.)

Medicine droppers

Plumber's plungers (2)

Anaeroid barometer

Mercurial barometer

References

Blanc, Sam S. and others. Modern Science 3. New York: Holt, Rineheart, and Winston, Inc., 1963.

Oxenhorn, Joseph M. and Michael N. Idelson. The Forces of Nature, ed. Peter Greenleaf. New York: Globe Book Company, Inc., 1968.

Natchitoches Parish Schools

UNIT REVIEW SHEET

Course_____ Teacher_____

Unit Title_____ Date_____

Beginning Date_____ End Date_____

I. Time Spent on Unit

Objectives	Estimated Time	Actual Time	Date Completed	Comments

II. Objectives Covered

A. Covered all objectives: Yes _____ No _____

B. Objectives not covered:

Objective Number	Reasons

III. Appropriateness of Objectives, Activities, Materials, and Evaluation.

A. All objectives were appropriate: Yes _____ No _____

B. Objectives not appropriate:

Objective Number	Reasons
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

IV. Suggestions for Improving the Unit

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UNIT V

HOUSE CARE SCIENCE

HEAT, LIGHT AND SOUND

UNIT V
Heat, Light and Sound

5-0-0 Upon completion of this unit the house care student will apply principles and theories relating to the use of energy in the home, as documented by a score of at least 70% on a teacher-made test.

5-1-0 In ten class periods the project teacher will provide activities identifying the nature of heat, as documented on the project monitorial system.

5-1-1 Identify, through discussion, physical and chemical changes produced as an effect of heat.

5-1-2 Discuss some inventions, such as thermostats, refrigerators, engines, etc., that use the physical effects of heat to mans' advantage.

5-1-3 Attach a 500 g weight to an iron wire about 1 meter in length and suspend from a ring stand. Apply heat from a candle and measure the amount of expansion of the wire.

5-1-4 Demonstrate the brass ball-and-ring apparatus.

5-1-5 Make a bimetallic bar by riveting together a brass strip and a steel strip. Test by holding it in a flame. Which way does it bend? Pour water on the bar. Which metal contracts more?

5-1-6 Using a discarded oven thermometer, remove the bimetallic parts and observe the effects of heating and cooling the coil.

5-1-7 Examine a discarded room thermostat, an electric iron or refrigerator thermostat. Explain how the thermostat starts the furnace operating.

5-1-8 Explain why holding tight jar lids in hot water makes them easier to loosen.

5-1-9 Show film - "Heat - Nature and Transfer"

5-1-10 Devise a thermo-electric junction by twisting the ends of a copper wire and an iron wire together. Attach the free ends to a galvanometer. Heat the twisted ends in a flame and note the galvanometer reading. Test other pairs of wires in the same way. Make a bar graph of your results.

5-1-11 Find some information about recent attempts to harness the sun's energy to heat homes and report on your findings.

5-1-12 Show films - "Energy and Matter" and "Energy and Its Transformation"

5-1-13 Make a solar heater by lining the inside of a funnel with aluminum foil. Focus the sun's rays on a test-tube half full of water. Record the change in temperature as a function of time. Make a graph of the results.

5-1-14 Show film - "Heat Convection and Radiation"

5-1-15 Make a report on refrigeration and how a refrigerator works.

5-2-0 In ten class periods the project teacher will provide activities pertaining to the nature of light and apply these principles to light in the home, as documented on the project monitorial system.

5-2-1 Identify light as a form of energy. Discuss some ways light is used, such as photosynthesis, cameras and photographs, images in our eyes, solar batteries, evaporation, etc.

5-2-2 Provide some of the following materials to demonstrate the action of light on: (a) transparent materials, (b) translucent materials, and (c) opaque materials

(a) window pane, cellophane, water
(b) waxed paper, tissue paper, frosted glass
(c) cardboard, wood, brick

5-2-3 Show films - "Light: Let's Talk About It" and "Nature of Light"

5-2-4 Devise a sundial to tell time using light. Hint: What does latitude have to do with the angle that the pointer makes with the dial?

5-2-5 Discover the nature of images produced by light by making a pin-hole camera. Cut one end from a round oatmeal box or metal can and cover with a piece of waxed paper. Punch a tiny hole in the other. Darken the room and look at a burning candle, allowing the light to pass through the pin-hole.

5-2-6 The speed of light in a vacuum is 186,000 miles per second. Calculate the time required for light to reach the earth from the sun. Show film - "Measurement of the Speed of Light"

5-2-7 Make a periscope and explain how it works.

5-2-8 Study the human eye and its operation. Dissect a cow's eye (obtained from a slaughter house) and discover its parts.

5-2-9 Visit an optometrist and find out how eyeglass lenses are ground.

5-2-10 Study the light that passes through a prism.

5-2-11 Use a light meter to measure the light reflected from different surfaces.

5-2-12 Show film - "Illumination and Its Measurement"

5-2-13 Make a report on some famous telescopes of the world.

5-2-14 Show film - "Lenses

5-2-15 Investigate color in soap bubbles. Use a bubble-making toy or colorless liquid soap and a soda straw. Dip the pipe or straw into the soap solution and slowly blow a bubble. Is there a relationship between the thickness of the film and the colors seen in the bubble? Do all of the colors of the spectrum appear?

5-3-0 In ten class periods the project teacher will provide activities on sound as documented on the project monitorial system.

5-3-1 Show that sound is waves of increased and decreased atmospheric pressure. Stand a drum on its side and hang a small weight so that it just touches one drumhead. Strike the other drumhead and explain what happens.

5-3-2 Discover the effect of the density of air on sound waves. Place a wind-up alarm clock on a foam rubber pad under a bell jar. Remove some of the air from the jar with a vacuum pump.

5-3-3 Invert a metal pie plate and touch it in several places with a vibrating tuning fork to investigate resonance.

5-3-4 Have a student fire a blank starter's pistol at a distance of 1 mile. Time, with a stopwatch, the difference between the appearance of the smoke and the arrival of the sound. How many feet per second does sound travel?

5-3-5 Show film - "Sound Recording and Reproduction"

5-3-6 Take apart an old auto horn and find out how it produces sound.

5-3-7 Report on the invention of the phonograph and explain the principle on which it operates.

5-3-8 Fill a series of drinking glasses with different amounts of water, so that they produce the notes of the scale when struck. Play a tune on them.

5-3-9 Find the purpose of a reed in a clarinet.

5-3-10 What is a sonic boom?

5-4-0 Unit Test

5-4-0 UNIT TEST: HEAT, LIGHT AND SOUND

Choose the best answer for each of the following:

1. Which of the following surfaces would absorb more radiant energy?

   (a) rough and white (b) rough and black (c) smooth and white (d) smooth and black

2. Materials that are poor conductors of heat are:

   (a) radiators (b) reflectors (c) insulators (d) liquids

3. Heat is transferred in a room mainly by:

   (a) insulation (b) convection (c) reflection (d) conduction

4. A device used to regulate and control thermal energy is a/an:

   (a) thermometer (b) calorimeter (c) insulator (d) thermostat

5. When a substance is heated, its molecules:

   (a) move more rapidly (b) get larger (c) get smaller (d) stop moving

6. Light rays will pass through substances that are:

   (a) transparent (b) opaque (c) translucent (d) reflective

7. The speed of light is about:

   (a) 186 miles per second (b) 186,000 meters per second
   (c) 186,000 miles per second (d) 186,000 miles per hour

8. The distance from the center of a lens to a point where the sun's rays come together to a point is the:

   (a) frequency (b) image (c) focal length (d) reflection

9. An image that can be focused on a piece of paper is a/an:

   (a) apparent image (b) real image (c) reflection (d) imaginary image

10. A bar made of two different metals which expand at different rates can be used to make:

    (a) a thermometer (b) a thermostat (c) both of these (d) neither of these

11. Our ears are sensitive to sound vibrations that occur at a rate of:

    (a) 0-20 vibrations per second (b) 20-20,000 vibrations per second
    (c) 20,000-200,000 vibrations per second (d) Over 200,000 vibrations per second

12. What would you use to strengthen sound waves?

(a) an accelerator (b) an alternator (c) an absorber (d) an amplifier

13. What part of a loudspeaker vibrates, producing sound waves in the air?

(a) Absorber (b) Brushes (c) Condenser (d) Diaphragm

14. When sunlight passes through a concave lens, the rays:

(a) are absorbed (b) are compressed (c) converge (d) diverge

15. The number of vibrations per second is the:

(a) compression (b) frequency (c) vocal length (d) resonance

INSTRUCTIONAL MATERIALS

Iron wire, 1 meter length

Brass ball-and-ring apparatus

Bimetallic bar

Discarded thermometers and thermostats

Galvanometers

Aluminum foil

Light meter

Assorted lenses

Soap bubble apparatus

Prisms

Bell jar and vacuum pump

FILMS:

"Energy and Its Forms"

"Energy and Its Transformation"

"Heat Conduction"

"Heat Convection and Radiation"

"Heat - Nature and Transfer"

"Light: Let's Talk About It"
"Illumination and Its Measurement"
"Lenses"
"Measurement of the Speed of Light"
"Nature of Light"
"Refraction"

"Sound Recording and Reproduction"

References

Blanc, Sam S. and others. Modern Science 3. New York: Holt, Rinehart and Winston, Inc., 1963.

Oxenhorn, Joseph M. Pathways in Science: Sound and Light. New York: Globe Book Company, Inc., 1970.

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